To: Hula, Aaron[Hula.Aaron@epa.gov]; Alson, Jeff[alson.jeff@epa.gov]
From: Dave Cooke
Sent: Tue 1/10/2017 9:15:22 PM
Subject: RE: Copy of EPA CO2/FE Trends Database, excluding production values--first of two emails

Thanks, Aaron.

From Novation, this is what they've cited as the foundation for their database:

Vehicle Attribute Database

•□□□□□□□□ *The vehicle attribute and performance database used for this assessment was generated, independent of this study, by Novation Analytics.*

•□□□□□□□□ *The MY 2016 Novation Analytics database includes over 1,400 individual vehicle models and subconfigurations offered for sale in the U.S. market. The database combines all vehicle and powertrain specifications with certification test parameters and results, including road load coefficients, equivalent test weights, fuel economy, and tailpipe CO2 emissions.*

•□□□□□□□□ *All data included in the Novation Analytics database were obtained from public sources including manufacturer's consumer and media websites, EPA Verify queries, and certification documents.*

That last bullet is the one that references the VERIFY database. Reading this again, however, it seems to me that 1400 models/powertrain options corresponds to the Fuel Economy Guide/Test Car List Data and not more detailed data, so it may be only that they did not themselves use VERIFY but perhaps spot-checked their analysis with the help of automakers.

Looking more closely at the Test Car List Data and some cert. sheets that I had previously thought had more detail, it actually looks like I was mistaken about there being a discrepancy in the level of detail, so I would have to look into this more with a specific problem in mind before I ask you to do any work. It seems entirely conceivable I am mistaken about the level of subconfiguration detail needed, and it has been awhile since I've really sat down and thought about this.

- Dave

From: Hula, Aaron [mailto:Hula.Aaron@epa.gov]
Sent: Monday, January 09, 2017 9:42 AM
To: Alson, Jeff; Dave Cooke
Subject: RE: Copy of EPA CO2/FE Trends Database, excluding production values--first of two emails

Dave,

Do you have a specific reference from Novation in mind? I was unaware that we had given them any VERIFY data directly. I'm happy to at least try and figure out what exactly we provided, and if it's something we can provide to the public.

You may already know this, but one thing to keep in mind is that there are two separate processes for determining fuel economy data that are a little different. First is the pre model year label process which all manufacturers have to go through before selling vehicles in the US and the second is the post model year GHG/CAFE process. The labeling process is more flexible and requires less data from manufacturers than the GHG/CAFE process. The data on fueleconomy.gov is all label data (even previous years).

In the spring of the calendar year after a model year (so we're coming up on MY 2016 data), manufacturers must submit all of the GHG/CAFE data. The requirements are more strict, and we do get more test data at this point, including footprint data. However I don't think we get data to the resolution you described - accounting for different electrical loads and exact curb weights. We could have a long conversation with the compliance division about what can and can't be aggregated under GHG/CAFE test groupings… but I think I'd need to call in the experts for that conversation.

Both the label and GHG/CAFE data are stored in VERIFY. The Trends data we sent is based on GHG/CAFE data, except for the MY 2016 data which is label data. However, I don't think the Trends data is enough for some of the things you're looking to do (we certainly don't carry A, B, C coefficients or curb weight). EPA does publish a lot of A, B, C coefficients in the Test Car List Data which is on the web. This is not necessarily a complete list, but does have data for many specific vehicle tests.

Hopefully this is somewhat helpful. Like I mentioned, I'm happy to track down what data (if any) we gave to Novation and if it's public if that's helpful.

Aaron

From: Alson, Jeff
Sent: Friday, January 06, 2017 8:10 PM
To: Dave Cooke <DCooke@ucsusa.org>
Cc: Hula, Aaron <Hula.Aaron@epa.gov>
Subject: Re: Copy of EPA CO2/FE Trends Database, excluding production values--first of two emails

Dave, all good questions. I hope the answer is that the public has the same access to the Verify data as industry consultants, but I am ignorant. I am also on leave now and won't be back in the office until February. I am copying Aaron, who is in a better position to respond, as he knows more about the database questions and can also interact with our Compliance Division colleagues.

Aaron, can you look into this?

From: Dave Cooke <DCooke@ucsusa.org>
Sent: Thursday, January 5, 2017 12:31 PM
To: Alson, Jeff
Subject: RE: Copy of EPA CO2/FE Trends Database, excluding production values--first of two emails

Jeff,

Thanks for passing on these documents—I'll take a look and see if I can provide any worthwhile feedback.

I've also been thinking about other data concerns, specifically about data needed for analysis around something like powertrain efficiency or other vehicle-specific, fleetwide analysis. Previously, I have utilized the Fuel Economy Guide (FEG) database (for something like

Automaker Rankings). However, that is only an incomplete picture of the fleet, with at most a couple different powertrains, whereas there are innumerable sub-models that share a powertrain but may have different weights or electrical loads that would not show up. Specifically the type of data that I could possibly want in an ideal world is: A, B, and C coast-down coefficients; curb/test weight; individual bin test fuel values; cert levels; etc.

In looking through the data used by Novation, they reference the use of Verify queries. It seems to me that there is a significant difference between the variety of models and details in the FEG database and the Verify database (or, more accurately, the baseline model data accompanying the TAR/TSD, which I assume was grabbed from Verify). Now, I've gone back to cert data before for individual models, the sheets for which are accessible via the OTAQ Document Index System, but those cert documents usually only refer to a couple specific models within a model line, and this data is then extrapolated in some way by the manufacturers to cover each and every vehicle sold. It would also be a time-consuming process to access up to 1000s of vehicles manually like that such that it just doesn't make sense.

One of the reasons why I ask this is while I can look at individual example vehicles, it seems like the ability to do some of this fleet-level analysis is restricted to industry-paid contractors. Is the Verify database restricted to the regulated parties? Or is there actually a way for the public to obtain access as well? Or are there other sources of this data available?

As an example, simply replicating the Novation Analysis seems difficult for someone not affiliated with the industry. If I've mischaracterized this or you can think of a way to obtain data at a level of detail exceeding the FEG database, I'd certainly appreciate it.

Thanks,

- Dave

From: Alson, Jeff [mailto:alson.jeff@epa.gov]
Sent: Wednesday, January 04, 2017 3:36 PM
To: Dave Cooke; Tonachel, Luke; John German; Nic Lutsey; Daniel Becker; John DeCicco; dlgreene@utk.edu; dwhm@uw.edu
Subject: Copy of EPA CO2/FE Trends Database, excluding production values--first of two emails

Last year, EPA received a FOIA request from Georgetown University for the Trends database, in its entirety. EPA determined that we could release most of the data publicly. The one part of the database that we cannot release at this point is the production/sales component, which we realize is a valuable part of the data. EPA is continuing to investigate if it would be possible to release the production data at some point in the future. The database includes data from MY 1975 through preliminary MY 2016. Due to file size, we had to split up the database, so this has the older rows and a second email will have the more recent rows.

The FOIA request and related files should be available on FOIA online in the coming weeks. Since we are sharing this data publicly for the first time, we wanted to share it with a few additional people outside of the agency that are regular users of the Trends report and might find the data useful. We consider this release a bit of a "beta" trial for releasing the data more widely, and would appreciate feedback if parts of the data or documentation are confusing. In addition, we would appreciate knowing if you are considering forwarding the database on to others, so that we can keep track of who has direct access to the database. Please keep in mind that the documentation was developed for EPA, not the general public.

There are a few additional notes that were provided as part of the FOIA:

1) The attached database is an export file from the Trends database, from the database version used to create the 2016 CO_2 and Fuel Economy Trends report. All production/sales data have been removed.

2) The data in the Trends database are based on data submitted by manufacturers for compliance with the GHG and CAFE regulations. However, it does not account for credits and other flexibilities that are part of both regulatory programs. This database alone **cannot** be used to assess regulatory compliance of any manufacturer or vehicle.

3) This database contains preliminary data for MY 2016. The MY 2016 data are subject to change when final values are submitted to EPA.

4) The manufacturer groupings in this data represent current market conditions for all past years for consistency of analysis. For example, Fiat-Chrysler is considered one manufacturer for all years in the report, even though that relationship only occurred a few years ago.

5) All weight data are based on inertia test weight classes and not individual vehicle curb weights, and may not be accurate enough for detailed analysis.

6) Footprint data prior to MY 2011 were aggregated from various sources. Data for MY 2011 on is from manufacturers. Therefore, there may be more uncertainty with the earlier footprint data. Especially in the case of large trucks with many footprint options, footprint data in some cases were aggregated and/or averaged across various configurations and may not be precisely correct for each row of the database.

7) EPA highly recommends reading sections 1 and 10 of the Trends report for more details on

the data and its limitations.

If there are any questions about the data please feel free to contact Aaron Hula at hula.aaron@epa.gov or (734) 214-4267, who is now the lead author on the Trends report. FYI, I am beginning a long vacation later today and will return sometime in February.

To: Alson, Jeff[alson.jeff@epa.gov]; Dave Cooke[DCooke@ucsusa.org]
From: Hula, Aaron
Sent: Mon 1/9/2017 2:42:06 PM
Subject: RE: Copy of EPA CO2/FE Trends Database, excluding production values--first of two emails

Dave,

Do you have a specific reference from Novation in mind? I was unaware that we had given them any VERIFY data directly. I'm happy to at least try and figure out what exactly we provided, and if it's something we can provide to the public.

You may already know this, but one thing to keep in mind is that there are two separate processes for determining fuel economy data that are a little different. First is the pre model year label process which all manufacturers have to go through before selling vehicles in the US and the second is the post model year GHG/CAFE process. The labeling process is more flexible and requires less data from manufacturers than the GHG/CAFE process. The data on fueleconomy.gov is all label data (even previous years).

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Cc: Anup Bandivadekar[anup@theicct.org]; NIc Lutsey[nic@theicct.org]; Joe Schultz[joe@theicct.org]; Aaron Isenstadt[aaron.isenstadt@theicct.org]
To: Charmley, William[charmley.william@epa.gov]; Olechiw, Michael[olechiw.michael@epa.gov]; Alson, Jeff[alson.jeff@epa.gov]; Alberto@ARB Ayala[Alberto.Ayala@arb.ca.gov]; Mike McCarthy[michael.mccarthy@arb.ca.gov]
From: John German
Sent: Tue 1/3/2017 2:58:15 PM
Subject: Re: Technology papers - incorporation into ICCT's comments on the Proposed Determination
ICCT Comments on 2022-25 Proposed Determination.pdf

ICCT submitted comments on the Proposed Determination on December 30. The link is as follows and I have attached a copy of our comments as well:
https://www.regulations.gov/document?D=EPA-HQ-OAR-2015-0827-6108

A substantial part of our comments involved taking the results from the technology working papers done in cooperation with suppliers and comparing them to a detailed assessment of the OMEGA model inputs for the Proposed Determination. **There are a substantial number of areas where the assumptions used for the Proposed Determination were overly conservative.** Table 8 (on page 16) of our comments summarizes the differences discussed in more detail in the preceding section. (Note that the lightweighting benefit in Table 8 is for the amount of weight reduction by 2025, not the efficiency benefit, as I didn't properly set up note d).

John

On Dec 19, 2016, at 3:37 PM, John German <john@theicct.org> wrote:

FYI, we just published our detailed working paper on lightweighting, written in cooperation with suppliers:
http://www.theicct.org/lightweighting-technology-development-and-trends-us-passenger-vehicles

Except for the diesel working paper, which we hope to publish in February, this is the last of our working papers. You can find the home page for all of the pages at:
http://www.theicct.org/series/us-passenger-vehicle-technology-trends
Note that the page includes both the detailed working papers we wrote with suppliers and the shorter ICCT technology briefs, so most of the subjects are listed twice.

Specific web links for the other detailed technology working papers are as follows:
http://www.theicct.org/downsized-boosted-gasoline-engines
http://www.theicct.org/automotive-thermal-management-technology
http://www.theicct.org/PV-technology-transmissions-201608
http://www.theicct.org/naturally-aspirated-gas-engines-201606
http://www.theicct.org/hybrid-vehicles-trends-technology-development-and-cost-reduction

Please let me know if you have any questions or would like additional information.

John

On Aug 29, 2016, at 2:29 PM, John German <john@theicct.org> wrote:

FYI, we just published our second detailed technology working paper, this one on transmissions. Dana, BorgWarner, ITB, and FEV contributed to this paper: http://www.theicct.org/PV-technology-transmissions-201608

Unfortunately, we have not yet finished ICCT's technology "brief" on transmissions, summarizing the results and adding a bit about implications on the mid-term review. I will let you know when this has been completed.

The papers on gasoline turbocharged engines and thermal management have finished supplier review and are now undergoing a final internal review by our communications team. The lightweighting paper was sent out for supplier review on Aug. 10, with their comments due by August 31. We are still hopeful that these can be finished by the end of September, with the paper on diesels following by the end of the year.

John

On Jun 21, 2016, at 10:51 AM, John German <john@theicct.org> wrote:

FYI, we just published two papers on naturally aspirated gasoline engines. These are the first in a series of technology reports in support of the 2017-25 mid-term review. Reports on transmissions, gasoline turbocharged engines, lightweighting, and thermal management will (hopefully) be finished by September, with a report on diesels following by the end of the year.

The first paper is the detailed working paper that we did in collaboration with Eaton, BorgWarner, and ITB.
Working paper: <http://theicct.org/naturally-aspirated-gas-engines-201606>

The second is ICCT's technology "brief", which summarizes the results of the working paper and adds a bit about implications on the mid-term review.
Tech brief: <http://theicct.org/naturally-aspirated-engines-techbrief-jun2016>

Let me know if you have any questions or want additional information.

John

Request Details
Request Type : *FOIA*

Status : *Assignment Determination* **Due Date :** *N/A*
0 (Never Started)

Submitted — Evaluation — Assignment — Processing — Closed

Tracking Number :	EPA-HQ-2017-003707	Submitted Date :	02/08/2017
Requester :	Kenneth von Schaumburg	Last Assigned Date :	02/08/2017
Organization :	Clark Hill PLC	Fee Limit :	$1,000.00
Requester Has Account :	No	Request Track :	Simple
Email Address :	kvonschaumburg@clarkhill.com	Due Date :	N/A
Phone Number :	202-772-0904	Assigned To :	Office of Transportation and Air Quality
Fax Number :	N/A	Last Assigned By :	Sabrina Hamilton (Office of Air and Radiation)
Address :	1001 Pennsylvania Ave., NW Suite 1300		
City :	Washington		
State/Province :	DC		
Zip Code/Postal Code :	20004		

Submission Details

Request Handling

Requester Info Available to the Public :	Yes	Request Perfected :	No
Request Track :	Simple	Acknowledgement Sent Date:	
Fee Category :		Unusual Circumstances ? :	No
Fee Waiver Requested:	No	5 Day Notifications:	No
Fee Waiver Status:	N/A	Litigation :	No
Expedited Processing Requested :	No	* Litigation Court Docket Number :	
Expedited Processing Status :	N/A		

Request Description

Short Description : N/A

Requesting Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation and Novation Analytics, LLC

Description Available to the Public : No
Has Description Been Modified? No
0/2000

Attached Supporting Files

Attachments Available to the Public : No

Attached File	Type	Size (MB)	Remove
von Schaumburg Rqst.pdf	PDF	0.60	

[redacted]

CLARK HILL

Clark Hill PLC
1001 Pennsylvania Avenue NW
Suite 1300
Washington, DC 20004
T 202.772.0909
F 202.772.0919

clarkhill.com

Kenneth von Schaumburg
T 202.772.0904
F 202.572.8685
C 202.403.9604
Email: kvonschaumburg@clarkhill.com

February 2, 2017

Via Regular and Electronic Mail

Ms. Sarah Dunham
Acting Assistant Administrator
Office of Air and Radiation
U.S. Environmental Protection Agency
Mail Code 6101A
1200 Pennsylvania Ave., NW
Washington, DC 20460
dunham.sarah@epa.gov

Mr. Christopher Lieske
Office of Transportation and Air Quality
Assessment and Standards Division
U.S. Environmental Protection Agency
2000 Traverwood Drive
Ann Arbor, MI 48105
lieske.christopher@epa.gov

National Freedom of Information Officer
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460

Re: Freedom of Information Act Request
Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation and Novation Analytics, LLC

To Whom It May Concern:

Pursuant to the Freedom of Information Act ("FOIA"), 5 U.S.C. § 552, and implementing regulations found in Part 2 of Title 40 of the Code of Federal Regulations, please provide copies of the following records in the custody or control of the Environmental Protection Agency ("EPA" or "Agency") between January 1, 2015 and the present:

1. All records of or concerning communications between EPA and the California Air Resources Board, the Union of Concerned Scientists ("UCS"), the International Council on Clean Transportation ("ICCT"), Ceres, Inc. ("Ceres"), Alan Baum of Baum & Associates, and/or Dan Luria concerning Novation Analytics, LLC ("Novation") or any of Novation's work.

2. All records of or concerning communications between EPA and UCS, ICCT, Ceres, Alan Baum of Baum & Associates, and/or Dan Luria concerning EPA's Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation (the "Proposed Determination"), including but not limited to Appendices A-C of the Proposed Determination.

3. All records of or concerning communications between EPA and UCS, ICCT, Ceres, Alan Baum of Baum & Associates, and/or Dan Luria concerning EPA's Draft Technical Assessment Report for the Model Year 2022-2025 Light Duty Vehicle GHG Emissions and CAFE Standards.

In order to assist you in the search, we are providing the following list of EPA personnel who may have been involved in such communications. Please note, however, that this list is not meant to be all-inclusive or otherwise limit the request for records identified above. Additionally, this request also covers any communications that may have been made via alternate, alias or personal email addresses. The relevant individuals include:

- Chris Grundler
- William Charmley
- Joe McDonald
- Michael Olechiw
- Kevin Bolon
- Robin Moran
- Ed Nam
- Cheryl Caffrey
- Jeff Cherry
- Ben Ellies
- Tony Fernandez
- Anthony Neam
- Kevin Newman
- Christopher Lieske

In addition to the EPA personnel identified above, the following persons may have been involved in such communications. Please once again note that this list is not meant to limit the request in any way, and is merely provided to assist you in the search. The relevant individuals include:

- Mike McCarthy, CARB
- David Cooke, UCS
- John German, ICCT
- Alan Baum, Baum & Associates
- Dan Luria

Please search for responsive records regardless of format, medium, or physical characteristics. Please produce records electronically in PDF or TIF format on a CD-ROM, organizing and identifying such records by the date on which they were originally created.

As you know, communications between EPA and outside parties are not normally exempt from disclosure under the FOIA. However, if, for some reason, you believe any portion of the requested records is exempt from disclosure, please provide an index of those documents, including the applicable exemption. If you believe that some portions of the requested records are properly exempt from disclosure, please disclose any reasonably segregable, non-exempt portions of the requested records. If it is your position that a document contains non-exempt portions of records and that those non-exempt portions are so dispersed throughout the document as to make segregation impossible, please state what portion of the document is non-exempt and how the material is dispersed throughout the document.

If you take the position that certain records or portions thereof are not required to be disclosed, please nonetheless consider disclosing the records on a discretionary basis. Doing so would be consistent with former Attorney General Holder's March 19, 2009 FOIA guidance to federal agencies, since that guidance counsels use of a presumption of openness. Moreover, the presidential memorandum dated January 21, 2009 commits executive agencies to an unparalleled level of transparency and accountability. *See* Memorandum on Transparency and Open Government, 74 Fed. Reg. 4685 (Jan. 26, 2009).

Pursuant to the FOIA, we agree to reimburse the Agency for reasonable charges incurred to search and copy these documents, upon presentation of an invoice with the finished copies. If it is anticipated that such search and production fees will exceed $1,000.00, please contact me in advance to obtain consent to such charges. If you have any questions concerning this request, please do not hesitate to contact the undersigned at (202) 772-0904 or by e-mail at kvonschaumburg@clarkhill.com; or Christopher Clare at (202) 572-8671 or cclare@clarkhill.com.

Thank you in advance for your assistance.

Sincerely,

Kenneth von Schaumburg
CLARK HILL PLC

CLARK HILL

THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

1225 I Street NW, Suite 900
Washington DC 20005
+1 202.534.1600
www.theicct.org

December 30, 2016

RE: Proposed Determination on the Appropriateness of the Model Year 2022–2025 Light Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation

The International Council on Clean Transportation (ICCT) welcomes the opportunity to provide comments on the *Proposed Determination* of the U.S. Environmental Protection Agency to maintain 2022-2025 standards. The ICCT is an independent nonprofit organization founded to provide unbiased research and technical analysis to governments in major vehicle markets around the world. Our mission is to improve the environmental performance and energy efficiency of road, marine, and air transportation in order to benefit public health and mitigate climate change.

We welcome this chance to comment onthe U.S. government's efforts to mitigate global climate change and reduce the demand for oil in the transport sector. We commend the U.S. EPA for its continuing efforts to promote a more efficient and lowercarbon economy, while being responsive to all stakeholders and relevant data. We hope these comments can help the agencies to fully meet their requirements to establish maximum feas ible and appropriate standards .

We would be glad toclarify or elaborate on any points made in the attached comments. If there are any questions, EPA, CARB and NHTSA staff can feel free to contactour U.S. program co-Leads, John German (*john@theicct.org*) and Nic Lutsey (*nic@theicct.org*).

Best regards,

Drew Kodjak
Executive Director
International Council on Clean Transportation

International Council on Clean Transportation comments on the *Proposed Determination on the Appropriateness of the Model Year 2022–2025 Light Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation*

Public submission to

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THE INTERNATIONAL COUNCIL
ON CLEAN TRANSPORTATION

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I. Overview

The International Council on Clean Transportation (ICCT) provides these comments to the Proposed Determination on the Appropriateness of the Model Year 2022–2025 Light Duty Vehicle Greenhouse Gas (GHG) Emissions Standards under the Midterm of the U.S. Environmental Protection Agency (EPA).

These comments support the proposed determination of the appropriateness of 2022-2025 standards for light-duty vehicles. The EPA has made a clear case that the GHG standards for 2022-2025 remain appropriate under the terms of the Clean Air Act and Midterm Evaluation. Although there is abundant technical evidence to make the standards more stringent, in the interest of maintaining regulatory certainty for industry investments, we agree that maintaining GHG standards for 2022-2025 is appropriate. Under the present circumstances, when federal and California authorities could modify or leave uncertainty around the 2025 standards , the best course of action is to solidify the 2025 standards as originally adopted.

The agencies have added an immense amount of new data related to technology developments that have occurred since the rulemaking. The new data clarifies how the standards are achievable and at lower cost than projected. This level of technical scrutiny over a vehicle regulation is, as far as the ICCT is aware, unprecedented globally by a very large margin. The transparency and availability of the data upon which to make a regulatory determination is also without parallel. The new data is thoroughly and transparently presented in the draft Technical Assessment Report (TAR), its Appendix, the Proposed Determination, and its comprehensive Technical Support Document. This body of work is fully responsive to every relevant question. In addition, among the dozens of state-of-the-art supporting technical reports, most of the key engineering report took the extra steps of expert peer-reviews. This expansive body of research has all been made available well in advance of the TAR and Proposed Determination releases. This has been very helpful for all of those stakeholders that have been interested enough to delve deeper into the technical details. The comprehensive technical work, public process, and transparency are to be commended.

In terms of the technical substance, the TAR and Proposed Determination analyses are generally accurate and complete, but do not always incorporate the latest technology developments. The massive new body of work from this Midterm Evaluation makes it clear that the greenhouse gas emission standards for 2022-2025 model years are built upon a strong technical foundation and can be met with cost-effective technologies. However, in the comments below, we do note several areas where the U.S. EPA could consider additional technology and cost inputs. Our comments below illustrate that it is easier than original anticipated to meet the 2025 standards as adopted, as the standards (1) can be met with known technologies with reduced costs from what U.S. EPA has indicated, (2) ensure a secure environment for efficiency technology investments, and (3) will aid in the international competitiveness of the U.S. auto industry.

II. Technologies to comply are available and low cost

We are generally very supportive of the technical analysis conducted by the U.S. EPA within the TAR and Proposed Determination. We concur with the major findings that the standards are working as designed, that there are many technical paths to comply with the 2025 standards with combustion technology, that automaker innovation is outpacing what the agencies projected in 2012, and that the costs are complying appear to be similar or lower than originally projected.

There is much to commend in the updated agency analyses, as documented in the TAR and the Proposed Determination. The agencies have conducted a massive amount of work toupdate the technologies and the technology assessments since the 2017 –2025 rulemaking. The most significant change was the addition of new highlyefficient, cost-effective naturally aspirated engines (i.e., high-compression Atkinson engines, like Mazda's SkyActiv) in EPA's analyses. This resulted in a reduction in the penetrations of turbo downsizing and hybridization for the EPA modeling. Both agencies also implemented a number of other updates, including a more cost effective 48-volt mild hybrid system, Miller-cycle turbocharging, variable geometry turbocharging, updated mass reduction costs, increased effectiveness of future 8-speed transmissions, updated battery cost modeling, and improved on -cycle stop-start effectiveness modeling. These improvements all reflect automaker and supplier innovations that are occurring and entering production. EPA's new physics-based Alpha model also offers a nice enhancement in modeling multiple technologies.

The agencies are also to be commended for their expanded use of rigorous peer-reviewed "tear-down" cost studies. Although expensive to conduct, these studies are typically more accurate and far more transparent than the older method of surveying manufacturers. Note that the 2015 National Academy of Science report spec ifically endorsed tear -down studies as the most appropriate way to get at costs.We also note that EPA and NHTSA both employ detailed and rigorous analytical methods and show relatively similar results, even though they conducted relatively independent analyses. This supports the robustness of the technology availability assessment and how there are multiple cost-effectiveness paths to comply with the 2025 standards.

Still, despite all of their new work and all of the updates, the re are some key areas where the agencies' analysis is still somewhat behind what is already happening in the market. For example, the agencies did not explicitly model e-boost, variable compression ratio, or dynamic cylinder deactivation. This is understandable, as it is critical for the agencies to have a robust, defensible analysis. But it also means that the agencies are always going to be somewhat behind in their assessments of potentially promising technologies. Our comments here are chiefly focused on U.S. EPA and its Proposed Determination, but we refer to the "agencies" more broadly, as the comments are also applicable to the California Air Resources Board and the National Highway Traffic Safety Administration in work on the TAR and their potential upcoming rulemaking analyses.

We emphasize that the single most important factor in the accuracy of cost and benefit for projections is the use of the latest, most up to date technology data and developments. Using older data guarantees that the cost of meeting the standard will be overstated, as it does not include more recent technology developments and thus must default to more expensive technology, such as full hybrids. Assuming that the end of innovation has been reached and basing projections on what is in production today ignores technology developments in process and overstates the cost of future compliance. In areas mentioned below, we suggest the agencies examine the latest technology developments and ensure that their technologies assessments include all existing and automaker-announced technologies as generally applicable by 2025. We also encourage the agencies to project how individual technologies will greatly improve over that period in cost and effectiveness, based on leading technology developers at auto manufacturing and supplier companies .

In preparation for the mid-term term review, ICCT has collaborated with automotive suppliers on a series of working papers evaluating technology progress and new developments in engines, transmissions, vehicle bod y design and lightweighting, and other measures that have occurred since then. The papers combine the ICCT's extensive analytical capacity and expertise in vehicle technology with the practical knowledge and experience of auto suppliers. Each paper evaluates how the current rate of progress (cost, benefits, market penetration) compares to projections in the rule, recent technology developments that were not considered in the rule and how they impact cost and benefits, and customer-acceptance issues, such as real-world fuel economy, performance, drivability, reliability, and safety.

Eaton, Ricardo, Johnson Controls, Honeywell, ITB, BorgWarner, Dana, FEV, Aluminum Association, Detroit Materials, and SABIC have contributed to one or more of the technology working papers. Papers on the following technologies are part of this series (all of the papers have been published, except for the diesel paper which is expected by February 2017):

- Hybrid vehicles[1]
- Downsized, boosted gasoline engines[2]
- Naturally aspirated gasoline engines, including cylinder deactivation[3]
- Transmissions[4]
- Lightweighting[5]
- Thermal management[6]
- Diesel engines[7]

The following technology discussion summarizes some of the most significant findings from these papers. The papers discuss many other technology developments, cost reductions, and consumer acceptance issues that can also help inform the mid-term evaluation and should be considered by the agencies. In addition, ICCT's European office contracted with FEV of Europe to develop updated cost and efficiency estimates to help assess technology availability in the European context in the 2025 timeframe.[8] The results from FEV's analyses were incorporated into the technology working papers and can also help inform the mid-term evaluation.

1 *John German (ICCT). Hybrid vehicles: Trends in technology development and cost reduction, July 23, 2015.* http://www.theicct.org/hybrid-vehicles-trends-technology-development-and-cost-reduction

2 *Aaron Isenstadt and John German (ICCT); Mihai Dorobantu (Eaton); David Boggs (Ricardo); Tom Watson (JCI). Downsized boosted gasoline engines,* http://www.theicct.org/downsized-boosted-gasoline-engines

3 *Aaron Isenstadt and John German (ICCT), Mihai Dorobantu (Eaton). Naturally aspirated gasoline engin es and cylinder deactivation, June 21, 2016.* http://www.theicct.org/naturally-aspirated-gas-engines-201606

4 *Aaron Isenstadt and John German (ICCT), Mark Burd and Ed Greif (Dana Corporation). Transmissions, August 29, 2016.* http://www.theicct.org/PV-technology-transmissions-201608

5 *Aaron Isenstadt and John German (ICCT); Piyush Bubna and Marc Wiseman (Ricardo Strategic Consulting);); Umamaheswaran Venkatakrishnan and Lenar Abbasov (SABIC); Pedro Guillen and Nick Moroz (Detroit Materials); Doug Richman (Aluminum Association), Greg Kolwich (FEV). Lightweighting technology development and trends in U.S. passenger vehicles, December 19, 2016.* http://www.theicct.org/lightweighting-technology-development-and-trends-us-passenger-vehicles

6 Sean Osborne, Dr. Joel Kopinsky, and Sarah Norton (The ITB Group); Andy Sutherland, David Lancaster, and Erika Nielsen (BorgWarner); Aaron Isenstadt and John German (ICCT). Automotive Thermal Management Technology, October 4, 2016. http://www.theicct.org/automotive-thermal-management-technology

7 *Diesel technology paper is in development and should be published byFebruary 2016.*

8 *FEV. 2025 Passenger Car and Light Commercial Vehicle Powertrain Technology Analysis. September 2015.*

Engine technology

The inclusion of new engine technologies generally reflects emerging technologies being deployed by suppliers and automakers since the original rulemaking. We first summarize noteworthy technology findings from the supplier literature. Then we note several engine technology developments where it appears that the agencies might be too conservative or restrictive in their technology assessment. For more information see the joint ICCT/supplier technology papers on naturally aspirated engines, downsized turbocharged gasoline engines, and thermal management.

High-efficiency naturally aspirated engines with Atkinson cycle and high compression ratio. The rulemaking assessments found that naturally aspirated engines would not be able to compete with turbocharged, downsized engines and would be almost completely replaced with turbocharged engines by 2025. The only exception was the continued use of Atkinson cycle engines on full hybrids (5% of the fleet), where the electric motor could offset the performance tradeoffs with the Atkinson cycle engine. However, Mazda has introduced a very high (13.0:1) compression ratio naturally aspirated engine with exceptional efficiency and is already using this on most of their vehicles.[9] Toyota has found ways to offset the performance losses with its Atkinson cycle engine, using variable valve timing and other techniques, and is expanding the use of Atkinson cycle engines to non-hybrid vehicles.[10] Toyota has announced that this technology will be in production soon.

Efficiency improvement estimates in the Proposed Determination for non-hybrid Atkinson Cycle engines with cooled EGR range from 3.4% to 7.7%, depending on vehicle class. These estimates are significantly lower than the estimates in the TAR, which ranged from 6.6% to 10.4%. And both are significantly lower than the estimates in the naturally aspirated technology working paper, which found that Atkinson cycle combined with high compression ratio and cooled EGR improved efficiency by 10% to 15%. These figures are summarized in Table 1.

Table 1. Fuel consumption reduction of Atkinson cycle, high compression ratio, cooled EGR engine technology

Vehicle	Proposed Determination vehicle type	TAR	Proposed Determination	ICCT technology report
Small car	LPW_LRL	10.3%	7.7%	12.5%
Standard car	MWP_LRL	7.5%	6.2%	12.5%
Large car	HPW	6.6%	6.9%	12.5%
Crossover	LPW_HRL	10.4%	6.8%	12.5%
Sport utility vehicle	MPW_HRL	7.6%	4.6%	12.5%
Large truck	Truck	8.3%	3.4%	12.5%
Average		8.5%	5.9%	12.5%

Dynamic cylinder deactivation. Cylinder deactivation was considered by the Agencies in the rulemaking, but only deactivation of groups of cylinders at a time. A new type of cylinder deactivation is in widespread development that allows each individual cylinder to be shut off

9 *Goto et al. "The New Mazda Gasoline Engine Skyactiv-G." MTZ worldwide Issue no.: 2011-06: 40-46. Accessed June 2016. http://www.atzonline.com/Artikel/3/13208/The-New-Mazda-Gasoline-Engine- Skyactiv-G.html*

10 *"Toyota claims record gasoline efficiency." Ricardo Quartlery Review Q2 2014, p. 4. Accessed June 2 016. http://www.ricardo.com/Documents/RQ%20pdf/RQ%202014/RQ%20 Q2%202014/RQ_Q2_2014_English.pdf*

every other revolution of the engine.[11] This technique reduces noise and vibration, extending cylinder deactivation to lower engine rpms and allowing 4-cylinder and even 3-cylinder engines to use cylinder deactivation. The agencies did not appear to explicitly model dynamic cylinder deactivation, and this technology could be quite important in the 2025 fleet.

The naturally aspired working paper found 1.5% to 4.0% incremental benefits for DCA over conventional deactivation. For conventional deactivation, the TAR and the Proposed Determination found smaller benefits on 4-cylinder engines than V6/V8. This should not be the case with dynamic cylinder deactivation, which should work just as well on a 4-cylinder, so 3.0% was added to 4-cylinder engines, and 2.5% to V6 and V8 engines.

Variable valve lift (VVL) is needed for dynamic deactivation. The cost estimate for VVL in the naturally aspirated technology report is 110 Euros, or $121 for a 4 -cylnder engine. In addition, the Joint TSD, p 3-81, states that engines equipped with "mechanisms required for cylinder deactivation" would only cost an additional $32 for NVH improvements. This $32 has been added to the FEV EU VVL costs. The rest of EPA's cost for conventional cylinder deactivation is not considered, as their costs primarily accounted for finger-follower de-lashing on a fixed block of cylinders (half the cylinders of a V6 or V8), which is not needed for dynamic cylinder deactivation. EPA's cost for conventional cylinder deactivation is based on finger-follower de-lashing on a fixed block of cylinders (half the cylinders of a V6 or V8), plus $32 for NVH improvements. These figures are summarized in Table 2.

Table 2. Technology cost and fuel consumption reduction for cylinder deactivation

	Cost			Fuel consumption reduction
	I4	V6	V8	
Proposed Determination – conventional deactivation	$88	$157	$177	3.5% - 5.8%
ICCT technology report – dynamic deactivation	$153	$247	$274	6.5% - 8.3%

Miller cycle for turbocharged engines. The Proposed Determination applied the additional costs for Atkinson cycle engines to Miller cycle engines: $93 for I4, $140 for V6, $222 for V8. This is not appropriate, as most of the cost of the Atkinson engine in the Proposed Determination was due to increased scavenging to maintain performance and extend the efficiency region. However, for the Miller cycle, this performance function is duplicative of the 24bar turbo system with a Variable Geometry Turbocharger also added in the Proposed Determination to maintain performance for the Miller cycle. Thus, the Atkinson-2 costs are valid for naturally aspirated engines, but should be removed for Miller cycle.

Variable Compression Ratio (VCR). Higher compression ratio improves efficiency, but at high engine loads it increases detonation, which is especially a problem for boosted engines.

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[11] *Wilcutts, M., Switkes, J., Shost, M. and Tripathi, A., "Design and Benefits of Dynamic Skip Fire Strategies for Cylinder Deactivated Engines," SAE Int. J. Engines 6(1):2013, doi:10.4271/2013-01-0359. Truett, Richard. "Cylinders take turns to deliver proper power." Auto News September 21, 2015. Accessed June 2016. http://www.autonews.com/article/20150921/OEM06/309219978/cylinders-take-turns-to- deliver-proper-power. "VW ACT Active Cylinder Management." Automotive Expo. YouTube, April 2014. Accessed June 2016. https://www.youtube.com/watch?v=_4AZbbBjqhM. Cecur, Majo, VeigaPagliari, D.R. "Dynamic Cylinder De-Activation (D-CDA)." PSA & Eaton. Presented at 24th Aachen Colloquim Automobile and Engine Technology. October 7, 2015.*

Variable compression ratio (VCR) changes the engine's compression ratio to suit particular speeds and loads. The benefits ofVCR overlap with those of Atkinson/Miller cycle, as both enable higher compression ratio. However, VCR does have one significant benefit over Miller cycle: it allows performance to be completely maintained at lower engine speeds. Thus, VCR may be a competitor to Miller cycle concepts in the long run, offering manufacturers more options to improve efficiency while maintaining performance. Nissan is implementing the first VCR application in a production turbocharged engine in MY2017.[12] The agencies did not appear to explicitly model variable compression ratio technologies t hat could be quite important in the 2025 fleet.

Direct injection, stoichiometry. FEV EU specifically calculated updated costs for gasoline direct injection.[13] Their cost estimates were $99 on a 1.0-L I3 turbo DI w/"higher pressure" rail than PFI system, $150 for 350 bar system on a 0.8-L i3, and $112 for a 1.4-L I4 w/"higher pressure" rail than PFI system. FEV's costs are scaled to V6 and V8 engines using FEV I3 cost divided by EPA's I3 cost. The technology working paper did not assess GDI efficiency benefits, so there is no change for efficiency. These figures are summarized in Table 3.

Table 3. Technology cost for direct injection

	Cost			
	I3	I4	V6	V8
Proposed Determination	$241	$241	$363	$436
ICCT technology report	$125	$112	$194	$233

Cooled EGR (gasoline). FEV EU specifically calculated updated costs for gasoline cooled EGR.[14] They calculated a cost of $116 for inline engines (C-segment 4-cyliner) and $140 for V engines (D- and E-segment V6). As the Proposed Determination did not include a separate estimate of efficiency for cooled EGR, we are unable to assess cooled EGR efficiency.

Table 4. Technology cost for cooled EGR

	Cost	
	Inline	V
Proposed Determination	$265	$265
ICCT technology report	$116	$140

Lightweighting technology

The agencies continue to systematically underestimate the extent to which lightweighting technology is available and could penetrate the fleet. The agencies' projection for model year 2025 has remained constant from the rulemaking to the TAR to the Proposed Determination, even though automakers are deploying greater amounts of mass-reduction technology. The

[12] _Nissan Global. (2016). Infiniti VC-T: The world's first production-ready variable compression ratio engine. August 14, 2016, https://newsroom.nissan-global.com/releases/infiniti-vc-t-the-worlds-first-production-ready-variable-compression-ratio-engine_

[13] _Aaron Isenstadt and John German (ICCT), Mihai Dorobantu (Eaton). Naturally aspirated gasoline engines and cylinder deactivation, June 21, 2016. http://www.theicct.org/naturally-aspirated-gas-engines-201606_

[14] _Aaron Isenstadt and John German (ICCT); Mihai Dorobantu (Eaton); David Boggs (Ricardo); Tom Watson (JCI). Downsized boosted gasoline engines, October 28, 2016. http://www.theicct.org/downsized-boosted-gasoline-engines_

agencies appear to continue to use contrived mass -reduction constraints that do not reflect automakers own confidence in safely reducing mass of vehicles.

Advances in modeling/simulation tools and joining techniques have opened the floodgates to unprecedented levels of material/design optimization. Suppliers are rapidly developing the advanced materials and methods for major lightweighting endeavors, as well as the computational tools for simulating full vehicles all the way down to nanoscopic material behavior. Many recent vehicle redesigns have reduced weight by at least 4%, already meeting or exceeding 2021 projections in the rule (Table 5). There are numerous material improvements in development that were not considered in the rule, such as higher strength aluminum,[15] improved joining techniques for mixed materials, third -generation steels with higher strength and enhanced ductility,[16] a new generation of ultra-high strength steel cast components, and metal/plastic hybrid components.[17] These developments are just a sample of the developments discussed in the joint ICCT/supplier technology working paper on lightweighting .

Table 5. Sample of vehicle mass reductions

Vehicle model	Model year	Weight reduction (kg)	Weight reduction (%)	Base year
Ford F-150	2016	288	14%	2014
Acura MDX	2017	172	8%	2013
GM Cadillac CTS	2017	95	5%	2013
Audi Q7	2016	115	5%	2015
Chrysler Pacifica	2017	146	7%	2016
Nissan Leaf	2016	59	4%	2012
Opel Astra	2016	173	12%	2015
Chevrolet Malibu	2016	135	9%	2015
GMC Acadia	2017	318	15%	2016
Chevrolet Volt	2017	110	6%	2014
Chevrolet Cruze	2017	103	7%	2015
Mazda Miata	2016	67	6%	2015
BMW M3/M4	2017	63	4%	2013
Chevrolet Equinox	2018	182	10%	2016
Chevrolet Camaro	2016	177	10%	2015

The agencies underestimate the likely deployment of lightweighting, especially since reducing vehicle weight has substantial consumer benefits in addition to the fuel savings, such as better ride, handling, braking, performance and payload and tow capacity. Further, high-strength steel, aluminum, and carbon fiber all have better crash properties than conventional steel, so increased adoption of these materials will improve the safety of the fleet – a factor that has not

[15] *Richard Truett. "Novelis: Automakers test stronger aluminum." Auto News. August 10, 2015. Web. Accessed July 2016. http://www.autonews.com/article/20150810/OEM01/308109982/novelis-automakers-test-stronger-aluminum*
[16] *Ryan Gehm. "NanoSteel confident its new AHSS is ready for volume production." Automotive Engineering. July 17, 2016. Web. Accessed July 2016. http://articles.sae.org/14908/*
[17] *Mana D. et.al "Body-in-white Reinforcements for Light-weight Automobiles", SAE technical paper # 2016-01-0399. Nagwanshi D. et.al, "Vehicle Lightweighting and Improved Crashworthiness– Plastic/Metal Hybrid Solutions for BIW", SPE ANTEC, technical program, 2016.*

been properly assessed by the agencies. These consumer benefits need to be incorporated into the agencies' analyses. The recent redesigns that reduced weight by at least 4% can be duplicated for each of the next two redesign cycles by 2025, likely doubling the agencies' estimate of weight reduction in 2025 to about 15%.

We are pleased to see the updated estimates for efficiency improvements due to lightweighting in the Proposed Determination and we completely support this revision. As background, in the analysis for the MYs 2012-2016 final rule, NHTSA and EPA estimated that a 10 percent mass reduction with engine downsizing would result in a 6.5% reduction in fuel consumption while maintaining equivalent vehicle performance (i.e., 0-60 mph time, towing capacity, etc.), consistent with estimates in the 2002 NAS report.

However, in the 2017-25 FRM, both agencies chose to use the effectiveness value for mass reduction from EPA's lumped parameter model to maintain consistency. EPA's lumped parameter model mass reduction effectiveness is based on a simulation model developed by Ricardo, Inc. under contract to EPA. The 2011 Ricardo simulation results show an effectiveness of 5.1 percent for every 10 percent reduction in mass. This value was also used in the TAR.

The ICCT supports EPA's updated estimates in the Proposed Determination (average 6.1% fuel consumption reduction per 10% weight reduction), as we believe the Ricardo simulation model results are not accurate. This is because Ricardo optimized every aspect of the powertrain for the baseline vehicle without weight reduction, but do not do a complete re-optimization of the powertrain after weight reduction was applied. Thus, their simulations underestimate the benefits of weight reduction.

A much better way to estimate the efficiency impacts of weight reduction for fully optimized powertrains is to derive them from the physical equations of motion. There is no theoretical reason why the weight of the vehicle should have a significant impact on the overall efficiency of comparable optimized powertrains. Thus, the appropriate way to estimate the efficiency benefits of lightweighting is to model the reduction in load over the FTP and highway test cycles. Given a specified vehicle (i.e., a vehicle with defined mass, rolling resistance, aerodynamic drag, and accessory load characteristics) and a specified driving cycle, it is possible to precisely calculate the tractive energy required for the vehicle to execute the driving cycle. The ratio of such energy requirements for changes in any of the vehicle specifications—in this case mass—can be taken as a direct indicator of changes in associated fuel consumption (and, by extension, CO_2 emissions). This was done by ICCT for development of post-2020 cost curves for Europe over 6 different vehicle classes.[18] Applying the same methodology to the US test cycles resulted in an average efficiency improvement of 6.3% for a 10% weight reduction.

The improved accuracy of EPA's updated fuel consumption reduction estimates can also be seen by comparing the estimates in the Proposed Determination to Meszler's energy model by class. EPA's estimates track the energy requirements nicely, supporting their revised estimates. Table 6 summarizes these costs and fuel consumption reduction impacts.

[18] *Dan Meszler, John German, Peter Mock, and Anup Bandivadekar (2016). CO2 reduction technologies for the European car and van fleet, a 2025-2030 assessment: methodology and summary of compliance costs for potential EU CO_2 standards.* http://www.theicct.org/co2-reduction-technologies-european-car-and-van-fleet-2025-2030-assessment

Table 6. Fuel consumption reduction for 10% weight reduction

Vehicle	Proposed Determination vehicle type	Energy Model example vehicle	TAR	Proposed Determination	Meszler Energy Model
Small car	LPW_LRL	Yaris	5.1%	5.5%	5.7%
Standard car	MWP_LRL	Camry	5.1%	6.3%	6.6%
Large car	HPW	300	5.1%	6.8%	6.8%
Crossover	LPW_HRL	Vue	5.1%	5.8%	6.2%
Sport utility vehicle	MPW_HRL	Grand Caravan	5.1%	6.2%	6.5%
Large truck	TRUCK	F150	5.1%	5.8%	6.2%
Average			5.1%	6.1%	6.3%

Thermal management, e-boost, and hybrid technology

Thermal Management. In the past decade, there has been a proliferation of new devices to control heat and reduce energy losses. More than 60 thermal management technologies are currently in production or development. This heightened pace of development is expected to continue for the next 10 years under regulatory pressure to reduce fuel consumption and carbon dioxide emissions. The Proposed Determination did not specifically address most of these technologies in baseline and projected future vehicles.

Thermal management systems in conventional powertrains are targeted primarily at improving efficiency, thus their primary evaluation metric is their effect on fuel consumption compared with cost. Thermal efficiency gains in the passenger compartments of conventional vehicles will mostly manifest as improved customer satisfaction and marketability.

There are 60-odd new thermal-management systems in development and over half are projected to cost less than $50 for each 1% reduction in fuel consumption. Passenger cabin technologies tend to cost more, but their primary benefit is in customer comfort, which adds additional value beyond the fuel savings. Thermal management gains can yield declines in fuel consumption on the order of 2% to 7.5% over the next 10 years, depending on a power train's base thermal-management features.[19] Note that the primary benefit of most thermal management systems are off-cycle, thus, the proper way to account for these benefits is to apply them to off-cycle credits.

E-boost. These systems comprise a higher voltage electrical system (48 volt) used to provide power for a small electric compressor motor within a turbocharger. This either directly boosts the engine, or spins up the turbocharger to greatly reduce turbo lag. This increases the ability to downsize and downspeed the engine and also reduces backpressure.[20] E-boost further allows the use of larger turbines with lower backpressure, for a direct reduction in BSFC in addition to the benefits from engine downspeeding/downsizing. The gasoline downsized boosted working paper found that total efficiency benefits are likely to be about 5% at a cost of about $400. The

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[19] *Sean Osborne, Dr. Joel Kopinsky, Sarah Norton, Andy Sutherland, David Lancaster, Erika Nielsen, Aaron Isenstadt, John German, Automotive Thermal Management Technology (ICCT: Washington DC, 2016). http://www.theicct.org/automotive-thermal-management-technology*

[20] *BorgWarner (2015). Technologies for enhanced fuel efficiency with engine boosting. Presented at Automotive Megatrends USA 2015, 17 March 2015. Slide 26*

first E-boost system application is in production on the 2017 Audi QS7.[21] The agencies did not appear to explicitly model e-boost technologies, and this technology could be quite important in the 2025 fleet. Note that e-boost has significant cost synergies with both Miller cycle, as the e boost system can compensate for the performance loss from the Miller cycle, and 48v hybrid systems.

48-volt hybrid systems. Unlike expensive full hybrids, 48v hybrid systems are not designed to power the vehicle. The lack of a large electric motor, the correspondingly smaller battery , and staying below the 60v lethal thresholdgreatly reduce the cost for this level of hybridization.[22] There are also excellent cost synergies with e-boost, as the same 48v controllers, inverters, and power electronics are used for both systems. We note that the TAR added analyses of 48v hybrid systems, but we recommend that the agencies investigate the synergies between 48v hybrids and e-boost systems.

The Proposed Determination has one cost for all 48v hybrids and the benefits go down as vehicle size increases. Thus, it is clear that the Proposed Determination is using the same 48v system on each vehicle.The turbo-downsized working paper estimated 10-15% benefit for 48v hybrids, with 12.5% as mid-range. To apply the same 48v system to each vehicle class, as was done in the Proposed Determination, the Proposed Determination percent im provements were ratioed by 12.5% divided by the average EPA benefit for the different classes without the truck class (which the turbo-downsized working paper did not consider). This results in 37% greater efficiency benefits for 48v hybrids, applied to each vehicle class. In EPA's Lumped Parameter Model (LPM) for the Proposed Determination, HEVs (including 48v hybrids) are penalized with a 48 percentage point increase in transmission losses. The reason for this is not known, but may help to explain the difference in the efficiency benefits. The cost estimates for 48v hybrids in the turbo-downsized working paper ranged from $600 to $1,000, very similar to the cost estimate of $766 in the Proposed Determination. Table 7 summarizes these costs and fuel consumption reduction impacts.

Table 7. Technology cost and fuel consumption reduction for 48-volt hybrid

	Cost	Fuel consumption reduction
Proposed Determination	$766	7.0%-9.5%
ICCT technology report	$600 - $1,000	9.6%-13.1%

Full hybrids. Much has been made of the market drop in full hybrid vehicles, corresponding to the drop in fuel prices. While full hybrids are sensitive to fuel prices, this is a very expensive technology that is not typical of the technologies available to comply with the standards. Most technologies are much lower cost and will not engender the same consumer resistance. This includes 48v hybrids that are only about 40% of the cost of a full hybrid and are projected by both ICCT and the agencies to capture a much larger share of the market in 2025 than full

[21] *Stuart Birch. "Audi claims first productionboosting on 2017 SQ7," Automotive Engineering, March 6, 2016, http://articles.sae.org/14662/*

[22] *Alex Serrarens (2015). Overview of 48V technologies, deployment and potentials. Presented at Automotive Megatrends USA 2015, 17 March 2015.*

hybrids.[23]. Full hybrids (nor going further with plug-in electric vehicles) are not needed to comply with the 2025 standardsfor most companies. Between the technologies that are already near production that were not included in the agencies' assessments in the TAR and the low penetration of Miller cycle and weight reduction projected for 2025, conventional technology will be more than enough for manufacturers to comply with the standards.

Electric vehicle technology

As stated above, we believe that electric vehicles are by and large unnecessary to minimally comply with the 2025 CO_2 standards. However, the agencies have accurately reflected how the prospects for electric vehicles have improved markedly in just the past se veral years, and that many companies are deciding to innovate and deploy technology in this area. EPA's incorporation of industry compliance with the California Air Resources Board's Zero -Emission Vehicle regulation as part of its reference fleet assessment is appropriate. This is appropriate as it reflects a clear industry trend to , at a minimum, comply with ZEV standards, and follows the agencies' precedent of included adopted regulatory compliance in the baseline fleet projection .

It is likely that the agencies' projection of electric vehicle deployment is less than what many companies will achieve in the 2025 timeframe. In 2014 and 2015, California electric vehicle deployment represented over 3% of new vehicle sales in the state. In CARB's 2012 regulatory assessment they projected that ZEV compliance would only deliver a 1.5% share of new vehicles in the 2014, and remain below 3% share of new vehicles through 2017. Based on these trends, we are seeing that industry as a whole is at least 3 -4 years in front of the ZEV requirements. Many companies, like General Motors, Nissan, Ford, and BMW are further out in front, greatly over-complying with the ZEV standards. Considering the market success of these advanced electric-vehicle technologies and over-compliance with adopted ZEV regulation, the NHTSA regulatory modeling framework appears to be out of step with industry, regulatory, and market dynamics by not incorporating ZEV technology similar to EPA . It would be appropriate for NHTSA, when they do their associated rulemaking, to similarly include technology deployment that is consistent with ZEV program compliance in its fleet modeling.

Overall the agencies appear to have overestimated electric vehicle costs. The agencies have utilized state-of-the-art tools including the DOE BatPac model on battery costs. Yet their costs calculations have erroneously pushed up electric vehicles' incremental costs to be approximately $10,000 per vehicle, in the 2025 timeframe. Based on our examination of detailed engineering cost files, we see U.S. EPA incremental technology costs for 100- and 200-mile BEVs of $9,000 to over $11,000 in 2025. We believe the agencies have overestimated these incremental technology costs, as the ICCT's recent analysis for a similar C-class compact car are approximately $3,100 to $7,300, respectively, for the same BEV ranges[24]. We suggest that the agencies re-examine the applicable BEV and PHEV technology costs, including the battery, non-battery, other powertrain cost factors, and the associated indirect costs for the technology.

[23] *German, J., (2015). Hybrid vehicles: Trends in technology development and cost reduction, July 23, 2015. International Council on Clean Transportation.* http://www.theicct.org/hybrid-vehicles-trends-technology-development-and-cost-reduction

[24] *Wolfram, P., Lutsey, N. (2016). Electric Vehicles: Literature review of technology costs and carbon emissions. International Council on Clean Transportation.* http://www.theicct.org/lit-review-ev-tech-costs-co2-emissions-2016

Response on industry technology assessment

The ICCT completely supports the assessment in the Proposed Determination of Novation's study[25] for the Alliance of Automobile Manufacturers. While the Novation study clearly defined what they did and didn't do, Novation did not actually evaluate technology potential. Instead, they duplicated the technology packages in the 2017 –2025 rulemaking and compared them to current vehicles using these technologies. As a result, the study used outdated technology assumptions and implicitly assumed there would be no technology innovations after 2014.

Novation's technology assessments did not incorporate projected improvements in each technology from 2014 to 2025, as EPA and NHTSA did in the rulemaking. Instead, Novation started with the 2014 distribution of engine efficiencies and assumed that the average efficiency of each technology in 2025 would be the same as the 90% percentile efficiency in 2014. The Novation study specifically states, "In the timeframe of the MYs 2012-2016 and MYs 2017-2025 rulemaking, however, it is not likely that the sales -weighted fleet performance will exceed the current boundaries established by the best in class vehicles utilizing many of the technologies listed above." This implicitly assumes there will be no technology innovations beyond what was already incorporated into some vehicles in 2014. Given the history of constant technology innovation, this assumption is completely unjustified. It is essentially the same as saying that the iPhone6 was the best smart phone in the market in 2014, so in 2025 the average smart phone will be the same as the iPhone6. Applying this methodology to vehicle technology is no better than applying it to smart phones.

As a specific example of an unfounded assumption, Novation's study stated: "the current compression ignition (24-29 bar maximum BMEP diesel) can be used as a representative proxy as it is unlikely even an advanced SI package will exceed the current CI efficiency boundary." It is accurate that 2025 SI (spark ignited, or gasoline) engines must exceed the efficiency of current CI (compression ignition, or diesel) engines. But any competent analysis of upcoming powertrain technology (like those referenced by US EPA in its analysis) finds that 2025 gasoline engine powertrains will exceed current diesel powertrain efficiency. Novation's assumption makes for a good sound bite, but it has no analytical basis.

To illustrate the shortcomings of Novation's approach, Novation's found that the 90th percentile efficiency for naturally aspirated engines, which they used as the average efficiency for 2025 naturally aspirated engine, was 22.8% (with high-spread transmission without stop/start). However, Novation's own data showed that the 2014 Mazda SkyActiv engine already had an efficiency of 25.1%. This is 10% higher than Novation's 2025 estimate — and almost as high as the average 2014 diesel engine (26%) — with 11 years of improvements yet to come. Another flaw is that Novation simply duplicated the technology set that was used in the rulemaking. As this technology set is 5 years old, Novation implicitly froze the level of innovation at the 2012 level. Not only did Novation ignore all future technology innovation, it also ignored all technology innovation that has occurred in the last 5 years. Overall, there is some interesting information in the Novation study on the efficiency of the 2014 fleet, but it uses old data (5-year old technology sets) and assumption that there are no improvements beyond what was in the better vehicles in the 2014 fleet makes it applicability limited The EPA analysis and the technical studies that

[25] *Novation Analytics. Final Report - Technology Effectiveness – Phase I: Fleet-Level Assessment (version 1.1), prepared for: Alliance of Automobile Manufacturers Association of Global Automakers, October 19, 2015. http://www.autoalliance.org/cafe/cafe-research-reports*

underpin its findings utilize the most rigorous state-of-the-art technology simulation and teardown methods; these are in stark contrast to Novation's backward-looking analysis.

Technology cost implications

The implications of the above technical comments, if incorporated in the agencies' modeling, would be substantial in reducing the estimated technology costs to comply with the 2022-2025 standards. Removing artificial near-term restrictions on technology applicability (e.g., on high-compression ratio engines, transmission technologies, mass reduction) could reduce compliance costs for 2022-2025 regulatory compliance by several hundred dollars per vehicle. Inclusion of new technologies, like e-boost, variable compression ratio, or dynamic cylinder deactivation, for example, and expansion of very cost-effective technologies, like Miller cycle and lightweighting, would expand the technology horizon and further reduce average compliance costs from the agencies' conservative technology estimates. The full inclusion of off-cycle technology for 2022-2025 model year vehicles would also likely lower estimated compliance costs. The inclusion of ZEV regulation compliance by EPA is appropriate based on automakers' current plans to comply with those regulations.

Table 8 summarizes the efficiency technology fuel consumption benefit and cost assessments. The benefits are in percentage fuel consumption per mile reduction, and the costs are the average cost increment per vehicle. These are a selection of the technology inputs that underpin the Proposed Determination, and comparable numbers from ICCT's analyses of recent vehicle efficiency technology developments and trends. Based on our assessment of these technologies, it is already abundantly clear that the 2025 standards will be significantly easier and cheaper to meet than predicted in the Proposed Determination. This indicates the agencies could have set more stringent standards and still met the same cost-effectiveness criteria. It also shows that EPA has been very conservative in their technology assumptions.

Table 8. Technology cost and fuel consumption reduction for cylinder deactivation

	Fuel consumption benefits (average) [a]		Cost (average) [b]	
	Proposed Determination	ICCT technology reports	Proposed Determination	ICCT technology reports
Cylinder Deactivation	4.4%		$125	
Dynamic cylinder deactivation		7.1%		$204
Direct Injection			$313	$165
Cooled EGR			$265	$128
E-boost	Not included	5.0%	Not included	$400
48v Hybrid	8.8%	12.0%	$765	$600 - $1,000
Atkinson Cycle	5.9%	12.5%		
Miller Cycle (turbo)		Varies [c]		$129 lower
Thermal Management		5%		$250
Lightweighting (2025 fleet average)	7%	15%		
Electric vehicle			$9,000-$11,000	$3,100-$7,300

[a] *Average for 6 different vehicle classes*
[b] *Weighted 50% 4-cylinder, 35% V6, 15% V8 (except as noted)*
[c] *Includes Atkinson Cycle, 24bar turbocharging, cooled EGR, and engine downsizing*
[d] *Fleet average*

III. Regulatory certainty secures industry investments

Although there is sufficient evidence to develop even more stringent standards, in the interest of maintaining regulatory certaintyfor industry investments, we believe that maintaining EPA's adopted GHG standards for 2022-2025 is appropriate. Maintaining 2022-2025 regulatory stringency would assure a stable regulatory environment. Any new uncertainty about the federal 2025 standards would provoke uncertainty with California and other states (representing as much as one third of the U.S. market) continuing with adopted 2025 regulatory standards.

Destabilization of the 2025 standards would put grave uncertaintyon the returns on the billion-dollar investments that automakers and suppliers have made. Table 3 highlights a selection of industry investments in the U.S. related to automobile efficiency technology[26]. As shown, the investments represent many thousands of high -tech manufacturing jobs and billions of dollars in investments. The success and sustainability of such technology investments depends on a stable regulatory environment. There is a clear connection between the standards and investments that directly contribute to American jobs. Maintaining the standards would protect high-technology manufacturing investments in efficiencytechnologies, whereas weakening or uncertainty about the standards jeopardizes such investments.

ICCT completely supports EPA's assessment in the Proposed Determination of the jobs study by the Center for Automotive Research (CAR). ICCT recently wrote a detailed critique[27], discussing the multiple problems with this study. In short, the whole report rests on a false premise about the costs of meeting the standards. CAR ignored the dozens of recent state-of-the-art technology analyses and, instead, the report relies on costs from a twenty -five-year-old retail-price manipulation strategy. A 1991 study by David Greene[28] found that automakers could improve their CAFE fuel economy level by increasing the sales price of less fuel efficient models while simultaneously decreasing the price of more fuel efficient models. Greene concluded that this pricing scheme is effective in the shortrun for fuel economy improvements of *up to* 1 mpg, and would cost $100–$200 (in 1985 dollars). But, Greene also found, for fuel economy improvements greater than 1 mpg, pricing out less -efficient vehicles generates increasing losses for automakers and improved technology and design changes are by far the more cost-effective solution for long-term, large fuel economy improvements. CAR ignored Greene's findings on mpg changes of more than 1 mpg and applied the retail-price manipulation results to the 2025 standards. Further, CAR ignored the economy-wide jobs created by reduced spending on fuel after the first 3 years of ownership.

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26 *Lutsey, N. (2012). Regulatory and technology leadtime: The case of US automobile greenhouse gas emission standards. Transport Policy. 21: 179-190. http://www.sciencedirect.com/science/article/pii/S0967070X12000522*

27 *Isenstadt, A. (2016). The latest paper by the Center for Automotive Research is not what it thinks it is http://www.theicct.org/blogs/staff/latestpaper-by-CAR-is-not-what-it-thinks-it-is*

28 *Greene, D.L., (1991). Short-run pricing strategies to increase corporate average fuel economy http://onlinelibrary.wiley.com/wol1/doi/10.1111/j.14657295.1991.tb01256.x/abstract*

Table 9. Auto industry investment and job growth related to efficiency technologies

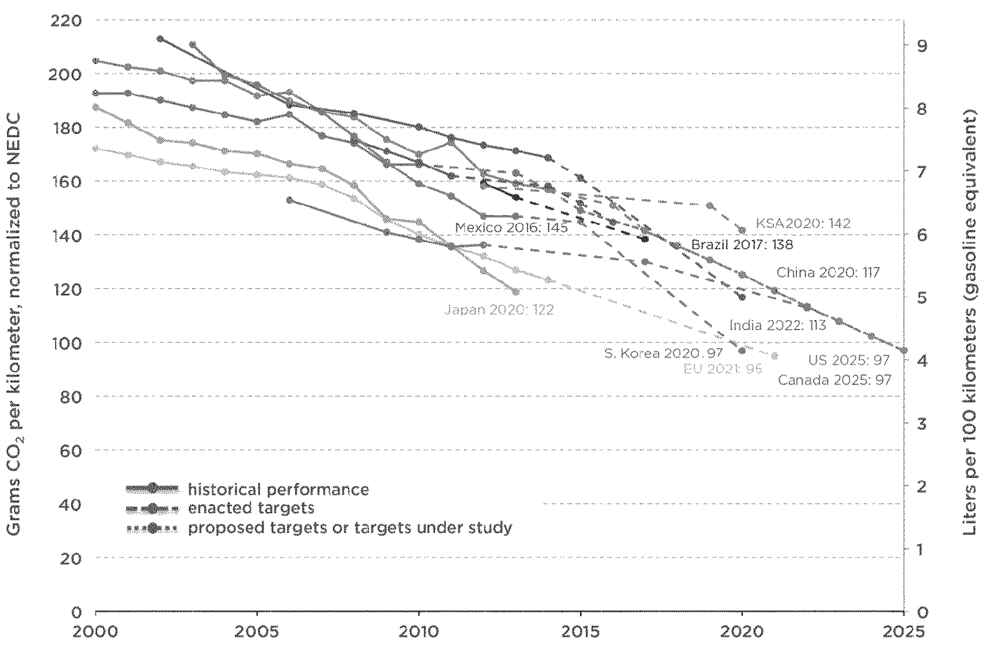
Company	Technology	Location	Jobs	Investment
Ford	Efficient engines (EcoBoost)	Cleveland, Ohio	250	$55 million
GM	Efficient engines (Ecotec)	Tonawanda, New York	350	$825 million
GM	Efficient engines (Ecotec)	Spring Hill, Tennessee	483	$483 million
GM	Engine, transm., stamping	Lordstown, Ohio	1200	$500 million
Hyundai	Efficient engines	Montgomery, Alabama	522	$270 million
Chrysler	Engine (FIRE)	Dundee, Michigan	150	$179 million
ZF	Transmissions	Laurens County, South Carolina	900	$350 million
Toyota	Transmission, aluminum parts	Buffalo, West Virginia; Jackson, Tenn.; Troy, Missouri	40	$64 million
GM	Transmission, electric motors	White Marsh, Maryland	200	$246 million
Fiat-Chrysler, ZF	Transmission (8-speed)	Kokomo, Indiana		$300 million
Bosch	Gasoline injectors, diesels	Charleston, South Carolina	300	$125 million
Michelin	Tires	South Carolina	100	$350 million
Lenawee Stamping	Metal stamping	Tecumseh, Michigan	140	
Tenneco Autom.	Emission control	Michigan	185	$15.6 million
Gestamp	Stamping	Chattanooga, Tennessee	230	$90 million
Gestamp	Steel components	Mason, Michigan	348	$74 million
ThyssenKrupp	Steel	Mount Vernon, Alabama	2700	$3700 million
Nanshan	Aluminum extrusion parts	Lafayette, Indiana	200	$100 million
Magna	Composite parts	North Carolina	327	$10 million
BMW, SGL	Carbon fiber parts	Moses Lake, Washington	80	$100 million
Faurecia, Ford	Plastic parts	US and Mexico	350	
TRW, Ford	Electric power steering	Marion, Virg; Rogersville, Tenn.	115	$55 million
Continental, Ford	Engine, brakes, tires, access.	Henderson, North Carolina	60	
Nexteer Autom.	Driveline, steering	Saginaw, Michigan		$431 million
Denso	Aluminum parts	Hopkinsville, Kentucky	80	$4.2 million
NHK	Suspension parts	Bowling Green, Kentucky	100	$20 million
Ford	Fuel-efficient, hybrid, electric vehicles	Louisville, Kentucky	1800 (7000)	$600 million ($1000 million)
V-Vehicle	Hybrid vehicles	Monroe, Louisiana	1400	$248 million
GM	Battery, drivetrain, engine, generator	Brownstown, Hamtramck, Warren, Bay City, Grand Blanc, and Flint, Michigan	1000+	$700 million
Nissan	Electric vehicles, components	Smyrna, Tennessee	1300	$1700 million
Magna	Electric drive components	Michigan	500	$49 million
Ford	Batteries, transaxles	Rawsonville, Sterling Heights, Michigan	170	$135 million
Toda America	Batteries	Battle Creek, Michigan	60	$35 million
JC-Saft	Batteries	Holland, Michigan	550	$299 million
LG Chem	Batteries	Holland, Michigan	400	$151 million
Fortu PowerCell	Batteries	Muskegon Township, Michigan	1971	$625 million
Bannon Autom.	Electric vehicles	Onondaga County, New York	250	$26.6 million
A123	Batteries	Ann Arbor	5000	$600 million
Magna	Batteries, drivetrain, power electronics, flexible foam	Auburn Hills, Troy, Shelby Township, Lansing, Michigan	500	$50 million
Toyota, Tesla	Electric vehicles	Fremont, California	1000	$50 million

Source: Lutsey, N. (2012). Regulatory and technology leadtime: The case of US automobile greenhouse gas emission standards. Transport Policy. 21: 179-190. http://www.sciencedirect.com/science/article/pii/S0967070X12000522

Furthermore and relatedly we would encourage the federal agencies to assess the prospects for continued 2026-2030 standards with increasing stringency at 5% lower CO_2 emissions and fuel consumption per model year. There are clearly a lot of available efficiency technologies, including a lot of advanced combustion technology that is not being deployed in the fleet by many companies. The agencies are not yet anywhere near their full authority of implementing maximum feasible and technology-forcing standards. Starting analysis toward 2030 standards would also be consistent with the agencies' precedent in setting standards with long lead-time of 12-13 years (i.e., setting 2025 standards in 2012). This would also be helpful for the federal agencies to remain engaged in a 2030 discussion, because California appears likely to begin work on 2030 climate policies that are also in the national interest of encouraging petroleum reduction and energy independence. This would also be consistent with efforts in Europe to assess longer-term 2030 CO_2 targets to increase lead-time to support industry investment and international competitiveness.

IV. National standards support competition in a global market

The U.S. fuel economy and greenhouse gas regulations have the U.S. fleet headed in the same direction as most other major world automobile markets, reducing per-mile carbon dioxide (CO_2) emissions at approximately 3% per year. About 80% of world automobile sales are regulated to increase their efficiency and reduce carbon emissions. Like the U.S. standards, all other standards around the world are indexed to vehicle size (or mass), and therefore require that efficiency technologies like those described above are deployed in the fleet. Figure 1 shows the progression of global efficiency standards in major world car markets.[29] In the U.S. case, industry has consistently over-complied with 2012-2015 standards while the industry overall achieved U.S. vehicle sales at their all-time highs, and with most companies producing high profits. Compliance with the standards helps ensure that U.S.-based companies embrace leading technology and remain internationally competitive elsewhere around the world. Conversely, the weakening standards make it more difficult for U.S.-based companies to compete in the major automobile markets around the world, including Europe and China, which have increasingly stringent efficiency standards.



* Note that Japan has already exceeded its 2020 statutory target, as of 2013.

Figure 1. Passenger car efficiency standard CO_2 emissions

[29] *International Council on Clean Transportation, 2015. Global passenger vehicle standards.* *http://www.theicct.org/info-tools/global-passenger-vehicle-standards*

V. Summary

The EPA has comprehensively and satisfactorily considered the relevant factors as required per the terms of Clean Air Act section 202(a) and Midterm Evaluation in making its proposed determination to maintain model year 2022 -2025 standards. In summary we conclude with the following points in favor of finalizing the determination –

- Considering the availability and effectiveness of technology, and the appropriate lead-time for introduction of technology, maintaining 2022-2025 standards as adopted is the wisest course of action. The rapid development of powertrain improvements to gasoline vehicles in particular continues to provide ever-abundant opportunities for manufacturers to predominantly comply with incremental internal combustion technology . Fuel-efficient vehicle technologies are available and only need to partially penetrate the fleet to comply with the 2025 standards, further indicating that the regulation's lead-time was appropriately gradual for industry compliance by deploying known technologies.
- The cost of the standards (an additional $875 per vehicle, per EPA's latest estimation) on the producers and the purchasers of new motor vehicles make for a highly cost-effective regulation, with three time higherbenefits than costs.
- The feasibility and practicability of the standards has clearly been established by EPA's state-of-the-art technology, compliance, and economic modeling assessments and peer-reviewed research. The record goes further by clearly indicating the standards could be set more stringently by greater deployment of known costeffective technologies.
- The impact of the standards on reduction of emissions, oil conservation, energy security, and fuel savings by consumers require that EPA maintain the standards. The EPA analysis shows the fuel savings are several times greater than the vehicle technology costs, even when lower fuel prices are included. The analysis also indicates that the standards save the U.S. over1.2 billion barrels over the regulated vehicle lifetimes, meaning the consumer savings aggregate to massive reduction in oil use nationally Underscoring the importance ofat least maintaining the 2025 standards, recent trends toward higher vehicle activity and larger vehicles suggest that EPA would need to make more stringent standards to achieve the originally proposed benefits to oil consumption and emissions. Any relaxation of standards would further jeopardize the U.S. energy security and increase American consumers' fuel expenditures.
- The impacts of the standards on the automobile industry have been thoroughly assessed. The auto industry has consistently over -complied with 2012-2015 standards while achieving near-all-time U.S. automobile sales and profit growth. Beyond the agency analysis, from an international perspective, the automobile industry's compliance with the standards will help ensure they embrace leading technology and remain internationally competitive. Conversely, weakening standards would make it more difficult for U.S.-based companies to compete in the major automobile markets around the world like Europe and China, which have increasingly stringent efficiency standards.
- EPA has appropriately considered all applicable aspects of light-duty vehicle sales, the projected fleet mix, and consumer acceptance. The continuation of footprint-indexed greenhouse gas standards that are based on vehicle fleet mixappropriately accommodates the changing fleet mix due to market shifts, as well as from the changing costs for gasoline and other fuels. Accounting for market shifts and emerging technologies that have high consumer acceptance, EPA has rigorously considered the regulation's impact on consumer vehicle payback periods.
- EPA has appropriately found that the regulation can be met with predominantly with incremental combustion technology (i.e., 95% of new vehicles in 2025 are not plug-in

electric technology). To the modest extent that electric vehicles will be deployed, EPA has considered the necessary charging infrastructure.

- The impacts of the standards on automobile safetyhave been assessed by the agencies. Efficiency technologies, including lightweighting technology, continue be deployed in ever-safer vehicles, as more detailed computer tools to assess every aspect of vehicle for efficiency simultaneously result in more crashworthy vehicle designs. State-of-the-art automaker lightweight vehicle offerings that are already in the fleet demonstrate that the fleet can still see further weight reduction without adverse impacts on safety.
- The EPA has considered the impact of the greenhouse gas emission standards on the Corporate Average Fuel Economy standards and a national harmonized program. Appropriately, EPA has provided ample auto industry flexibilities through technology credits, emission trading, smaller volume company provisions, and footprint indexed standards to accommodate fleet shifts. TheseEPA provisions greatly assist automobile industry compliance. Based on the well-designed EPA flexibilities, any further improvement toward a harmonized one national program would best be addressed with adjustments in the Corporate Average Fuel Economy, matching NHTSA's program with EPA's improved manufacturer flexibilities. Appropriately, EPA has included California's Zero-Emission Vehicle program compliance in their compliance scenarios, as automaker are expected to comply with ZEV program as part of their national fleet deployment. Locking in the US EPA greenhouse gas program through model year 2025 provides the best chance at keeping one consistent federal-and-California regulatory program.
- Another relevant factor is that that companies have made major billion -dollar technology investments that are predicated upon a stable regulatory environment. Beyond the environmental and energy independence benefits, these high-tech investments directly contribute to American manufacturing jobs. Any weakening of the standards would directly undercut vehicle technology investments. Furthermore, decreased U.S. investments in efficiency technology would put U.S.-based companies in a weaker position to deploy their products in the largest global markets, like Europe and China.

To: Charmley, William[charmley.william@epa.gov]; Olechiw, Michael[olechiw.michael@epa.gov]; Moran, Robin[moran.robin@epa.gov]; Wysor, Tad[wysor.tad@epa.gov]; Lieske, Christopher[lieske.christopher@epa.gov]; Bolon, Kevin[Bolon.Kevin@epa.gov]; Helfand, Gloria[helfand.gloria@epa.gov]
From: Alson, Jeff
Sent: Sun 1/1/2017 11:47:43 PM
Subject: Quick overview of major NGO comments on PD

Robin asked for a short overview based on 6 major environmental NGOs (NRDC, UCS, ACEEE, ICCT, EDF, and CBD, Center for Biological Diversity) and 3 major non-environmental NGOs (Consumers Union, Consumer Federation of America, and BlueGreen Alliance). Others should add to this if I missed anything particularly important from these NGOs. I printed all of these comments out, and they are in a brown folder on my desk if anyone wants to read a hard copy with some highlights.

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

To: Bolon, Kevin[Bolon.Kevin@epa.gov]; Olechiw, Michael[olechiw.michael@epa.gov]; Moran, Robin[moran.robin@epa.gov]
From: Lieske, Christopher
Sent: Sat 12/31/2016 12:44:46 PM
Subject: Novation Analytics Comments
Novation_Analytics.pdf

To: Barba, Daniel[Barba.Daniel@epa.gov]; Bolon, Kevin[Bolon.Kevin@epa.gov]; Moran, Robin[moran.robin@epa.gov]; McDonald, Joseph[McDonald.Joseph@epa.gov]; Neam, Anthony[Neam.Anthony@epa.gov]; Cherry, Jeff[Cherry.Jeff@epa.gov]; Moskalik, Andrew[Moskalik.Andrew@epa.gov]; Kargul, John[kargul.john@epa.gov]; Sherwood, Todd[sherwood.todd@epa.gov]; Helfand, Gloria[helfand.gloria@epa.gov]; Lieske, Christopher[lieske.christopher@epa.gov]; Brown, Jarrod[Brown.Jarrod@epa.gov]; Yanca, Catherine[yanca.catherine@epa.gov]
From: Olechiw, Michael
Sent: Fri 12/30/2016 5:19:38 PM
Subject: FW: Alliance of Automobile Manufacturers Comments on Proposed Determination and Technical Support Document (EPA-HQ-OAR-2015-0827)
Alliance of Automobile Manufacturers Comments on Proposed Determination (2016-12-30).pdf
Attachment1_DefourGroup_Alliance_PD_Response_re_Regressivity_of_Standards.pdf
Attachment2_Novation_Analytics_MY2016_Baseline Study_20dec2016_v1.0.pdf

Alliance comments

From: Michael Hartrick [mailto:MHartrick@autoalliance.org]
Sent: Friday, December 30, 2016 12:06 PM
To: Lieske, Christopher <lieske.christopher@epa.gov>
Cc: Charmley, William <charmley.william@epa.gov>; Moran, Robin <moran.robin@epa.gov>; Olechiw, Michael <olechiw.michael@epa.gov>; Jim Tamm (james.tamm@dot.gov) <james.tamm@dot.gov>; Yoon, Rebecca (NHTSA) <rebecca.yoon@dot.gov>; McCarthy, Mike@ARB (michael.mccarthy@arb.ca.gov) <michael.mccarthy@arb.ca.gov>
Subject: Alliance of Automobile Manufacturers Comments on Proposed Determination and Technical Support Document (EPA-HQ-OAR-2015-0827)

Dear Mr. Lieske,

Attached, please find comments from the Alliance of Automobile Manufacturers on the Proposed Determination and associated Technical Support Document. These comments and referenced attachments have also be submitted to via regulations.gov. Thank you for your time and consideration of these comments.

Mike Hartrick

Director of Fuel Economy and Climate

Alliance of Automobile Manufacturers

Desk (248) 357-4717 x103

Mobile Ex. 6 - Personal Privacy

MHartrick@autoalliance.org

To: Bolon, Kevin[Bolon.Kevin@epa.gov]; Silverman, Steven[silverman.steven@epa.gov]; Safoutin, Mike[safoutin.mike@epa.gov]; Helfand, Gloria[helfand.gloria@epa.gov]
Cc: Moran, Robin[moran.robin@epa.gov]
From: Lieske, Christopher
Sent: Fri 12/30/2016 5:09:30 PM
Subject: FW: Alliance of Automobile Manufacturers Comments on Proposed Determination and Technical Support Document (EPA-HQ-OAR-2015-0827)
Alliance of Automobile Manufacturers Comments on Proposed Determination (2016-12-30).pdf
Attachment1_DefourGroup_Alliance_PD_Response_re_Regressivity_of_Standards.pdf
Attachment2_Novation_Analytics_MY2016_Baseline Study_20dec2016_v1.0.pdf

From: Michael Hartrick [mailto:MHartrick@autoalliance.org]
Sent: Friday, December 30, 2016 12:06 PM
To: Lieske, Christopher <lieske.christopher@epa.gov>
Cc: Charmley, William <charmley.william@epa.gov>; Moran, Robin <moran.robin@epa.gov>; Olechiw, Michael <olechiw.michael@epa.gov>; Jim Tamm (james.tamm@dot.gov) <james.tamm@dot.gov>; Yoon, Rebecca (NHTSA) <rebecca.yoon@dot.gov>; McCarthy, Mike@ARB (michael.mccarthy@arb.ca.gov) <michael.mccarthy@arb.ca.gov>
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Mike Hartrick

Director of Fuel Economy and Climate

Alliance of Automobile Manufacturers

Desk (248) 357-4717 x103

Mobile Ex. 6 - Personal Privacy

MHartrick@autoalliance.org

To: Bolon, Kevin[Bolon.Kevin@epa.gov]
Cc: Sahni, Shobna@ARB[ssahni@arb.ca.gov]
From: Mader, Pippin@ARB
Sent: Tue 12/6/2016 6:09:44 PM
Subject: RE: a few questions on Control Tec, Aero, P/W

Kevin,

Sorry for not getting back yesterday, I keep thinking we will have the 2015 Novation data, but it has been delayed twice and now Greg indicated he has a personal matter he has to attend to, we don't have an estimated timeline to get the dataset.

It sounds like we can discuss the details at today's OMEGA meeting.

Thanks, Pippin

Pippin Mader, P.E.

California Air Resources Board

Desk: 916-445-8113

Cell: 530-400-6047

From: Bolon, Kevin [mailto:Bolon.Kevin@epa.gov]
Sent: Monday, December 05, 2016 10:02 AM
To: Mader, Pippin@ARB
Subject: FW: a few questions on Control Tec, Aero, P/W

Hi Pippin,

Following up on our game of phone-tag two weeks ago, I now have a bit of time to investigate the relative differences between EPA's and Novation's MY2015 fleet data. Can you give me an update on what's included in the file that you have, and the potential for sharing it?

I think that we'll finally be able to have our bi-weekly OMEGA meeting tomorrow, so we can talk about it then.

Thanks!
Kevin

From: Sherwood, Todd
Sent: Friday, November 18, 2016 1:57 PM
To: Bolon, Kevin <Bolon.Kevin@epa.gov>
Subject: FW: a few questions on Control Tec, Aero, P/W

Kevin – do you have any time to reply or call Pippin regarding these questions? I don't feel like I'm the right person to answer them.

From: Mader, Pippin@ARB [mailto:pippin.mader@arb.ca.gov]
Sent: Friday, November 18, 2016 1:39 PM
To: Sherwood, Todd <sherwood.todd@epa.gov>
Subject: a few questions on Control Tec, Aero, P/W

Todd,

We have a few questions on:

- Is Novation (aka Control Tec) data used for 2015 fleet? Part of the reason Novation said they took so long to get us the 2015 data was there was a larger difference between 2014 and 2015, according to them.

- Is the new Aero methodology a best in class thing? Does it go beyond Aero2?

- What is the effect of the Power to Weight (P/W) based method, it seems like it makes higher

P/W vehicles have opportunity for more reductions, assuming they aren't turbo, how do you deal with DTS vehicles?

- What was the overall effect in cost space for this analysis?

Feel free to call me whenever you have time,

Pippin

Pippin Mader, P.E.

California Air Resources Board

Desk: 916-445-8113

Cell: 530-400-6047

To: Bolon, Kevin[Bolon.Kevin@epa.gov]
From: Sherwood, Todd
Sent: Fri 11/18/2016 6:56:55 PM
Subject: FW: a few questions on Control Tec, Aero, P/W

Kevin – do you have any time to reply or call Pippin regarding these questions? I don't feel like I'm the right person to answer them.

From: Mader, Pippin@ARB [mailto:pippin.mader@arb.ca.gov]
Sent: Friday, November 18, 2016 1:39 PM
To: Sherwood, Todd <sherwood.todd@epa.gov>
Subject: a few questions on Control Tec, Aero, P/W

Todd,

We have a few questions on:

- Is Novation (aka Control Tec) data used for 2015 fleet? Part of the reason Novation said they took so long to get us the 2015 data was there was a larger difference between 2014 and 2015, according to them.

- Is the new Aero methodology a best in class thing? Does it go beyond Aero2?

- What is the effect of the Power to Weight (P/W) based method, it seems like it makes higher P/W vehicles have opportunity for more reductions, assuming they aren't turbo, how do you deal with DTS vehicles?

- What was the overall effect in cost space for this analysis?

Feel free to call me whenever you have time,

Pippin

Pippin Mader, P.E.

California Air Resources Board

Desk: 916-445-8113

Cell: Ex. 6 - Cell Phone

To: Moskalik, Andrew[Moskalik.Andrew@epa.gov]; Bolon, Kevin[Bolon.Kevin@epa.gov]; Olechiw, Michael[olechiw.michael@epa.gov]; Cherry, Jeff[Cherry.Jeff@epa.gov]
From: Moran, Robin
Sent: Thur 11/17/2016 7:08:32 PM
Subject: FW: quick thought on novation
distributions for novation.png

From Mike McCarthy…

From: McCarthy, Mike@ARB [mailto:michael.mccarthy@arb.ca.gov]
Sent: Thursday, November 17, 2016 1:19 PM
To: Olechiw, Michael <olechiw.michael@epa.gov>; Moran, Robin <moran.robin@epa.gov>
Subject: quick thought on novation

In reading the chapter 99 appendices or whatever it is called, I had a thought on the Novation rebuttal.

First, in a couple of places the tone makes it sound a little personal or over the top on trying to point out how insufficient or simplistic it is. You might want to take a fresh read to make sure you keep it as objective as desired.

Second, I think there is still something we aren't quite hitting on with respect to the assumption that the fleet efficiency can only get to the upper edge of where it is now. Greg argues that you can use the 75th or 95th percentile of today's cars and move the average up to there and that is about all you can do. I apologize for the crudely drawn sketch--I'm on vacation and had to do it quickly. So the red distribution is where cars are today and the red line is the 95th percentile so you assume the green distribution--all cars essentially at that peak efficiency. We argue that is overly conservative to say the best you are going to get already exists and so it can't be right. But, I think that argument is forgetting that Greg argues the blue distribution is equally represented by his assumption---some will do better and some won't get all the way there and so you end up with the average up there but certainly some products will do better. I think that is their counter to no, we didn't assume today's best are the best that it will ever get.

But, I still think his argument has some flaws. First, it gets me confused when using that as a fleet average efficiency assumption or an individual vehicle efficiency assumption and which is appropriate. Second, I think just moving the same kind of distribution to the right (from red to blue) is also not quite right because the red represents today, before they have the kind of efficiency pressure that the future standards will bring to bear. I wonder if we could reasonably argue that a future distribution might be more like the yellow (drawn poorly) but the idea that OEM's wont be able to afford to be on the left side of that distribution (aka worse than the best available today)---everyone will have to be at least that good. But, there will also be folks that do better and you end up with a less normal distribution or one that puts the average/mean to the right of the best available today. Can we reasonably argue that nobody in their right mind will be able to afford to leave that kind of efficiency gain on the table ---something that is already being done in the 2014/2015 fleet--by 2025. They will have to at least be doing that by 2025 and then others will move the needle even further?

I'm not sure the best way to make the argument or if you think it holds water but I'm concerned the current rebuttal leaves the door open a little too much for an easy response by them to say--no, we didn't assume the green distribution, we assumed the blue one and that means we did protect for things to do better than what is available today. Greg has tried to rationalize moving the average of the fleet up to that level would be significant compared to what gains have been made in the past but I also think that the past, without any significant GHG or FE pressure, is not a good predictor of what OEMs will need to focus on going forward so I think that helps deflate his argument about it being ambitious to think the fleet average could move that far in the next 10 years.

Call me on cell Ex. 6 - Personal Privacy if you or Andy or somebody wants to talk through this or it doesn't make any sense.

novation analytics

December 30, 2016

<u>Via Federal Rulemaking Portal: http://www.regulations.gov</u>
<u>Docket ID No. EPA-HQ-OAR-2015-0827</u>

The Honorable Gina McCarthy
Administrator, U.S. Environmental Protection Agency
Office of the Administrator 1101A
1200 Pennsylvania Avenue, N.W.
Washington DC 20460

Christopher Lieske
Office of Transportation and Air
Quality Assessments and Standards Division
U.S. Environmental Protection Agency
2000 Traverwood Drive
Ann Arbor, MI 48105

RE: Novation Analytics' Comments on the Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation (Docket ID No. EPA-HQ-OAR-2015-0827)

Dear Administrator McCarthy and Mr. Lieske:

The United States Environmental Protection Agency's ("EPA") Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards Under the Midterm Evaluation ("Proposed Determination") includes an Appendix A [1] [1] dedicated to two studies conducted by Novation Analytics ("Novation") [2, 3]. Much of what is presented in Appendix A (and referenced in the body of the Proposed Determination) is based on misrepresentations of the methodologies used by Novation in the two studies. For your convenience, a short comparison of EPA's critiques, alongside of Novation's actual methods, are presented in the table below. A more detailed analysis is found in the attached document.

[1] Values in brackets [ ] denote references found at the end of the attached document

EPA Critique	Novation Analytics' Actual Method
The studies did not assume advancement of powertrain technologies and, therefore, minimal advancement of powertrain effectiveness.	The studies did assume technology advancement, evaluating agency-defined powertrains from the final rule-making ("FRM") [4, 5]. The resulting effectiveness levels were as much as 33% greater than the MY 2014 averages.
The studies assumed only MY 2014 powertrains and did not allow for the recombination of technologies.	The studies did not assume only MY 2014 powertrain combinations: powertrain maps were developed for technology combinations described in the FRM.
The studies omit vehicle load technologies.	The studies included vehicle load technology advancements and used the same loads described in the FRM.
The studies' constraints are arbitrary and lack technical foundation.	The studies' constraints are not arbitrary; all constraints were cited and accounted for, some based on EPA published data.

As background, Novation is a policy-neutral organization and our clients for the Mid-Term Evaluation ("MTE") include the California Air Resources Board ("CARB"), the Alliance of Automobile Manufacturers ("Alliance"), the Global Automakers, and the Department of Transportation ("DoT") through the Volpe National Transportation Center ("Volpe"). Furthermore, Novation's (formerly Control-Tec) prior work for CARB [6] was used to support the development of the draft Technical Assessment Report ("TAR") [7]. An element of this study was used by EPA in the Proposed Determination; however, EPA chose not to reference the original work.

In the spirit of collaboration, any data or process issues found during the course of these studies were communicated to all stakeholders (prior to the draft TAR), with the goal of enhancing the MTE process. The results of the studies were shared, as early as March 2015, with all three stakeholder agencies. Specifically, Novation conducted multiple on-site visits to CARB (Sacramento, CA), EPA (Ann Arbor, MI), Volpe (Cambridge, MA), and the National Highway Traffic Safety Administration ("NHTSA") (Washington, DC).

Additionally, the Alliance, Global Automakers, and Novation repeatedly offered their time to answer any questions regarding the two studies. The EPA team did not respond to these offers. Despite our overtures, EPA's critiques are largely based on blogs [8,9], rather than fact-checked and peer-reviewed sources.

Given these facts, which are presented in more detail in the attachment, EPA must retract and correct its characterizations of Novation's methods in accordance with the attached.

Respectfully submitted,

Greg Pannone
President, Novation Analytics
2851 High Meadow Circle, Suite 160
Auburn Hills, MI 48326

Introduction

The United States Environmental Protection Agency's ("EPA") Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards Under the Midterm Evaluation ("Proposed Determination") includes an appendix [1, Appendix A] dedicated to two studies conducted by Novation Analytics ("Novation") [2, 3]. The evaluation of the studies by EPA include misrepresentations of the actual methods and assumptions employed by Novation.

The Novation studies referenced in Appendix A, and elsewhere in the Proposed Determination, were requested by the Alliance of Automobile Manufacturers ("Alliance") and Global Automakers, and are a retrospective evaluation of the model years ("MY") 2012 to 2025 final rule-making ("FRM") [4, 5] modeling results. The objective of the studies was to provide an independent review of the FRM processes with the goal of improving the efficacy of the Mid-Term Evaluation ("MTE") process. The studies were not an assessment of the draft Technical Assessment Report ("TAR") [7] or any other work generated by the agencies following the publication of the FRM.

EPA's main argument is that Novation simply assumed MY 2014 technology and levels of powertrain efficiency, making no consideration for powertrain and vehicle load technology advancements. On the contrary, the Novation studies assumed:

1. The same powertrain technology pathways published in the FRM, which included aggressive turbocharging with engine displacement downsizing, high efficiency and high ratio spread transmissions, stop-start, and multiple levels of electrification.
2. The same vehicle load reductions published in the FRM, which included aerodynamic drag and tire rolling resistance reductions of up to 20% in addition to mass reductions of up to 10%.

The conclusions and recommendations from these reports can be summarized as follows:

<u>*Conclusions*</u>

1. The powertrain technology pathways published in the FRM are not sufficient to support the MY 2021 and 2025 standards.
2. Based on conclusion #1, more efficient powertrain technologies than assumed by the FRM (and using the agency assumptions for mass reduction, aerodynamic drag reduction, and tire rolling resistance reduction) will be required to achieve the standards.
3. Conclusion #1 is the result of FRM process issues associated with the vehicle-level modeling for fuel economy and tailpipe CO_2 emissions. Two particular areas of concern are:
   a. The lumped parameter model ("LPM") [10] has fundamental deficiencies that cause under-projection of tailpipe CO_2 for many individual vehicles.
   b. The Ricardo modeling results [11] used to calibrate the LPM for the FRM fail basic plausibility checks.

Recommendations

1. Upgrade the LPM or replace it with another modeling method.
2. Remove the Ricardo modeling results from MTE evaluations.
3. Utilize powertrain efficiency to assess the sustainability of vehicle modeling results.

EPA has acknowledged recommendations #1 and #3 and has attempted to incorporate them into its modeling and quality control processes.

Specific feedback to Appendix A subsections are provided in the next sections.

A.1 Constraints on Technology Combinations and Technological Innovation

EPA's representation of Novation's assumption of non-advancement of technology is incorrect. These statements were also made by David Cooke [8].

EPA states [1, pages A-1, A-2]:

"*The most basic of the "fundamental mistakes" in the report, and one that directly affects all of the conclusions drawn by the Alliance on projected technology effectiveness, is the contention that all possible technology available in 2025 can be represented by technology already contained in the MY2014 baseline fleet ...*

... The methodology in the Novation report does not allow for the recombination of technologies represented by these packages, and thus severely and unduly limits potential effectiveness increases obtainable by MY2025."

This mimics David Cooke's blog [8]:

"The study assumes that over an 11 year span from 2014 to 2025, the average vehicle will not improve upon what is already available today. This is said with a straight face, despite noting at other points in the fact sheet "the industry's innovations" and how "manufacturers have accelerated the development of new technology.""

"*Among its seemingly arbitrary constraints, the study assumes that conventional vehicles will never match the levels of efficiency of today's diesel or hybrid-electric powertrains. Engineers have already previously broken this "constraint," with the Southwest Research Institute's HEDGE project matching diesel equivalency and Toyota's ESTEC platform matching the same level of efficiency as its Prius—there's no reason to accept such a limit at face value.*"

On the contrary, Novation modeled the agencies' FRM packages using alternative simulation methods and assumptions. Furthermore, Novation used the current powertrains as a foundation upon which it added the technologies assumed by the FRM. This is fundamentally the same process that the agencies use: measure the performance of current production powertrains and powertrain components to establish a baseline, then add those technologies and technology combinations that do not exist in the fleet today. The difference is simply system-level analysis versus component-level analysis. Questioning the validity of Novation's process of creating powertrain maps (actual baseline plus new technologies) suggests that EPA would also question its own approach.

As stated in the Executive Summary of the first Novation report [2, page 7]:

"Novation Analytics' full vehicle simulation software was utilized to model conversion efficiencies for each of the technology bundles considered by the agencies. The foundation of the powertrain efficiency maps used in the simulation software is data from thousands of actual production vehicle tests, providing an accurate fleet level assessment of conversion efficiency for a given technology implemented in a production, regulatory-compliant and customer acceptable application. Future technologies are layered onto this foundation and, through statistical analysis of powertrain efficiency, powertrain integration learning can be applied."

Novation used its ENERGY™ simulation software to generate the efficiency domain projections of the FRM technology pathways. ENERGY™ is a full-vehicle simulation software and, similar to EPA's ALPHA model [1, section 2.3.3.3], requires powertrain energy maps, vehicle load elements, and drive cycle details (e.g., vehicle speed versus time).

Novation goes on to describe the building of the maps, including combinations of technologies, to account for key information missing from the FRM including basic powertrain parameters required by any sustainable analysis including, but not limited to, engine displacement, compression ratio, and boost pressure [2, page 47]:

"The foundation of the powertrain maps is actual tests results that have been decomposed to the physics-based subsystem and feature contributions, analyzed and re-assembled as maps and analytics. Incorporating technology benefits reported from technical publications and other sources further enhances these maps. This approach creates a powerful tool calibrated to actual test results and capable of building and evaluating not only powertrain combinations that exist in the fleet today but also combinations that may be considered in the future, such as a compression ignition hybrid."

Table XIII [2, page 57] in the Novation report clearly shows the efficiency values resulting from the modeling. Novation found plausible cycle average efficiencies of up to 28.2% for advanced spark-ignition (SI) based powertrains with high ratio spread transmissions and stop start. This is 33% greater than the average of SI-based powertrains in MY 2014. These powertrain combinations are not in production nor do any current non-hybrid SI-based applications approach these cycle average efficiency levels. Novation's analysis of the FRM powertrain combinations was limited to an evaluation of efficiency and not, as EPA suggested [1, page A1], on the cost and production viability.

Contrary to David Cooke's statements, there are no production-viable products that have "*broken this constraint*" (HEDGE is not in production). The most efficient MY 2016 light-duty gasoline vehicle has an average cycle efficiency of 25.8% (combined cycle). Furthermore, by starting from a diesel map (the proxy), Novation is assuming diesel-like efficiency for an SI-based powertrain. By comparison, the average diesel powertrain in MY 2016 was 27.6% (combined cycle) against Novation's result of a 28.2% average for the best advanced SI-based powertrain studied. Cooke also incorrectly states that Toyota's Atkinson-cycle ESTEC platform matches the efficiency of the Prius. Cooke misinterpreted this statement [12]; the ESTEC platform matches the peak engine efficiency of the Prius (38%), not the average cycle efficiency of the Prius.

A.2 Novation's Simplistic Methodology and Lack of Rigor

This section is largely a restatement of A.1 with some added editorial that, again, incorrectly states the study methodology [1, page A-3] and mimics David Cooke's statement noted earlier:

"*... the Novation report assumes that no innovation will occur - no new technology will be implemented - in the eleven years until MY2025...*"

As shown earlier, the statement is incorrect. Further, EPA states [1, page A-2]:

"The methodology within the report is to survey the MY2014 fleet, grouping vehicles into broad "technology bundles" according to their powertrain. Within each bundle, the underlying technology was assumed to be identical, and any differences among powertrains attributed solely to "learning and implementation improvements." For example, one "bundle" is defined as an SI naturally aspirated engine coupled with a non-high ratio spread transmission, without stop-start. This bundle presumably includes vehicles with Atkinson cycle engines or cylinder deactivation, yet ascribes any efficiency gains due to the advanced technology to "learning.""

The vehicle packages studied were those used in the FRM as that was the overall objective of the study, not an evaluation of all technologies. The FRM represents a foundation for the MY 2022 through 2025 standards and, regardless of any new information published by EPA, the standards were established using specific vehicle and powertrain package assumptions reported in the FRM. It is the sustainability of these packages that Novation was requested to study, not alternative powertrain technologies that EPA may now be evaluating.

Novation's assessment of the technologies used in the FRM are detailed on pages 35 through 46 of the report [2]. Powertrain summaries of this information are provided in Tables VI through XI [2] and clearly state that these are from the results of the EPA and NHTSA studies. Any lack of detail was due, in large part, to lack of detail provided in the FRM. For example, EPA's LPM has no inputs for engine displacement, engine boost pressure, or engine compression ratio. Furthermore, key powertrain components, such as transmissions, were bundled into broad categories by EPA.

The LPM, on which most of Novation's analysis was focused, describes powertrains by broad technology packages. Consequently, Novation could only study the powertrain technology combinations as defined by EPA. In the Proposed Determination, EPA continues the practice of defining powertrains as broad technology packages; hence, by criticizing Novation, EPA is calling into question its own approach.

EPA goes on to pontificate about other technologies such as variable compression engines [1, page A-3]:

"*Moreover, the artificial limitation on innovation imposed in the Novation report completely discounts the effect of further innovation in the industry (such as, for example, Nissan's production-ready variable compression ratio engine, available in 2018), which may provide further cost-effective reductions in GHG emissions and fuel consumption. The Novation report assumes that new technologies like these (and others already announced by manufacturers to be utilized on future products), along with the fuel consumption benefits derived from them, would be impossible to incorporate in the future fleet.*"

Again, these technologies were not in the FRM. Nor are they included by EPA in the TAR or Proposed Determination. Therefore, Novation did not study them. Had they been in the FRM, Novation would have included them in the study.

Finally, regarding the use of diesel powertrains as a starting point for developing advanced spark-ignition powertrain maps, EPA states [1, page A-3]:

"No technical rationale for this choice is provided, and the report again relies on circular reasoning by using the argument that "it is unlikely even an advanced SI package will exceed the current CI efficiency boundary" to support the choice of using current CI powertrain efficiencies as a proxy for 27 bar SI engine powertrain efficiencies"

Novation did explain their technical rationale in the report [2, page 23]. While the combustion process is different (compression-ignition versus spark-ignition), the key attributes that allow diesel engines to achieve higher efficiencies than current spark-ignition engines are lower pumping losses, higher compression ratios, and dilute operation. These are the same benefits that EPA was claiming for the direct-injected, dilute, and highly boosted engines that served as the foundation of the FRM and, therefore, the MY 2022 through 2025 standards. Consequently, starting from the best diesel powertrain maps, and making adjustments for spark-ignition realities (e.g., lower compression ratios) provides a sustainable foundation for projecting the performance of these future powertrains.

A.3 Omission of Vehicle Load and Technology Penetration Rate Changes

Again, EPA misrepresents Novation's methodology and objectives; to evaluate the sustainability of the FRM powertrain effectiveness assumptions, not the vehicle load assumptions. The Novation study assumed the same mass, aerodynamic drag, and tire rolling resistance reductions as assumed by the agencies in the FRM and transposed those assumptions into the tractive energy domain [2, pages 15-19].

Related statements were made by David Cooke [8] regarding vehicle load, and these statements are also incorrect:

"The study largely ignores opportunities for reducing fuel usage beyond the engine, with lightweight materials being a particular oversight since the technology is already being deployed with levels of improvement exceeding those assumed by the study"

Furthermore, EPA attempts to discredit the Novation studies by suggesting that alternative powertrain pathways would have altered the assumptions for reduction in mass, aerodynamic drag, and tire rolling resistance [1, page A4]:

"*In an alternative world where powertrain technology cost-effectiveness is different, the EPA would revise its modeling and likely project a different mix of technologies in future fleets, as the cost effectiveness of each technology would likely change in comparison to the others.*"

However, in both the TAR and Proposed Determination documents, EPA uses the same, generic, assumptions for these parameters as it did in the FRM. Again, by criticizing Novation, EPA is calling into question its own assumptions.

A.4 Arbitrary and Restrictive Assumptions and Constraints

This section largely makes the same, baseless assumption that Novation limited technology growth [1, page A-4]:

"In addition to arbitrarily limiting technological progress to combinations existing in the fleet in MY2014, this Novation report likewise depends throughout on arbitrary assumptions and constraints which are largely unexplained, lacking in technical foundation, or unsupported by scientific rationale."

Novation made no such assumptions regarding technological progress. The second Novation report was largely a plausibility evaluation of the vehicle-level modeling results [3]. Contrary to EPA's assertions, the methodology was not arbitrary and was explained beginning on page 20 of the report.

Notably, EPA states [1, page A-4]:

"*calculation of powertrain efficiency can serve as a gross QC check on estimated technology effectiveness by quickly identifying the highest efficiency packages for further review*"

This is precisely what the second Novation study accomplished. For example, the Novation plausibility checks show individual vehicle simulations from the FRM that had <u>cycle average</u>

efficiencies that were higher than the peak engine efficiency of the best engine maps used in the FRM, which is an impossible outcome.

While EPA is critical of the Novation's plausibility checks it offers no hard data or alternative and instead relies on an illustrative example of an engine map that is not from an actual, tested engine. Furthermore, the technology assumed from this map was not included in the TAR or the Proposed Determination.

Assumptions and constraints were established by Novation when there was a lack of information published by EPA, which has been resistant to providing support for these studies. An April 28, 2015 e-mail from Michael R. Olechiw (Director, Light-duty Vehicles and Small Engines Center, US EPA) to Greg Pannone (President, Novation Analytics) states:

"With regard to Mike Reale's continued requests for information regarding LD GHG Phase 1, I am going to instruct my team to ignore all of his requests. We have repeatedly told Mike that he should reference the Phase 1 information but he disregards our instructions. If you would like to discuss this matter directly, feel free to call me."

A copy of this e-mail is available upon request. Mike Reale was one of the principal investigators on the Novation studies. The reason for the repeated requests was that the Phase 1 information publicly available was not sufficient to fully examine the results. The requests were simply seeking disaggregated LPM model results.

EPA continues to criticize the Novation report without basis [1, page A-4]:

"... the assumptions used to estimate plausibility limits are unduly conservative and not at all optimistic. In fact, the Union of Concerned Scientists identifies at least one current production vehicle, a Honda Fit, which would be deemed implausible by the Novation report methodology."

Again, EPA relied on David Cooke for input rather than to confer with the authors of the Novation reports. David Cooke's assertion that the Honda Fit would be implausible by the Novation assessment is also incorrect [8]:

"Finally, in a show of just how arbitrary the constraints imposed by the study were, a number of vehicles already on the road today would be considered "implausible" according to their metrics, including the Honda Fit. When the study can't even properly capture the vehicles of today, how can it possibly be trusted to assess the vehicles of tomorrow?"

Novation would not deem the Honda Fit implausible. The MY 2016 Fit is within the best 1% of SI-based powertrains, having a combined efficiency of 25.5%; yet, it is 12% below the stated plausibility limits established by Novation Analytics [3, page 23].

Relative to EPA's assessment of on-cycle-to-peak engine efficiency [1, page A-6]:

"Since the Novation report develops a plausibility limit for on-cycle-to-peak engine efficiency ratio based on a few MY2013-2014 vehicles, no room is left for potential improvement in the efficiency matching; this is yet another example of the Novation report using an overly restrictive initial assumption to dismiss potential technological improvement."

Again, EPA did not correctly state the Novation assumptions. On the contrary, Novation assumed future improvements to on-cycle-to-peak engine efficiency ratios of 19% on the city cycle, 10% on the highway cycle, yielding 15% combined [3, page 28].

Every quality control process must provide limits beyond which action should be taken. Yet, despite its critique of Novation, EPA developed no alternatives; rather EPA simply stated in the Proposed Determination [1, section 2.3.3.5] that the modeling results were acceptable.

A.5 Displacement Specific Load and Exemplars

EPA agreed with Novation regarding this topic [1, page A-6]:

"The EPA agrees that "displacement-specific load" is an important parameter in determining technology effectiveness."

However, it again misrepresents Novation's assessments [1, page A-6]:

"However, both the Alliance and their contractor, Novation, fundamentally misunderstand the purpose and usage of the LPM."

Novation did not misunderstand the reason for the LPM. Novation describes the agency modeling processes and replicates the agencies' zero-dimensional modeling results [3, pages 13-19]. In summary, the LPM is a simplified model of incremental fuel consumption and CO_2 effectiveness (a simple Microsoft Excel spreadsheet) that provides the processing speed required to support the OMEGA model [1, chapter 5]. If simplicity and speed were not the issue, then EPA's ALPHA model would have been used to generate CO_2 values for the OMEGA model, rather than injecting the extra modeling step and the overhead associated with supporting and calibrating a second model.

A.6 Other Studies

Despite EPA's attempt to connect the two studies, John Thomas' study was conducted independent of Novation's work. Thomas and Pannone are advisory panel members for the fueleconomy.gov website, which is administered by Oak Ridge National Laboratory, and collaborate on a regular basis, as is common in the industry.

Regardless of any connection to Novation, John Thomas' technical paper was peer reviewed, as are all publications by SAE International.

EPA goes on to state [1, A7]:

"In fact, the methodology in the Thomas paper is essentially identical to that in the Novation reports, and Thomas states in his paper that the work "was inspired and focused by many discussions with Gregg (sic) Pannone, Novation Analytics.""

The methodology used by Novation and John Thomas has been independently reported by other research [13, 14, 15, 16, 17, 18]. Consequently, to suggest that this approach is without merit is to suggest that these other authors and peer reviewers were also incorrect.

References

[1] United States Environmental Protection Agency, "Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation: Technical Support Document", EPA-420-R-16-021, November 2016.

[2] Novation Analytics, "Technology Effectiveness – Phase I: Fleet-Level Assessment (version 1.1)", October 19, 2015.

[3] Novation Analytics, "Technology Effectiveness – Phase II: Vehicle-Level Assessment (version 1.0)", September 20, 2016.

[4] United States Environmental Protection Agency and National Highway Traffic Safety Administration, "Light- Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards; Final Rule," Federal Register, Volume 75, May 7, 2010.

[5] United States Environmental Protection Agency and National Highway Traffic Safety Administration, "2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standard," Federal Register, Volume 77, October 15, 2012.

[6] Gregory Pannone, "Technical Analysis of Vehicle Load Reduction Potential For Advanced Clean Cars," (Contract 13-313), Final Report to California Air Resources Board and California Environmental Protection Agency, April 29, 2015. Available at http://www.arb.ca.gov/research/apr/past/13-313.pdf

[7] United States Environmental Protection Agency, National Highway Traffic Safety Administration, California Air Resource Board, "Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025," July 2016.

[8] David Cooke, "Five Deceptive Tactics Automakers Are Using to Fight Fuel Economy Standards," July 13, 2016, Union of Concerned Scientists, http://blog.ucsusa.org/dave-cooke/automakers-fuel-economy-standards.

[9] Alam Baum and Dan Luria, “Why We Believe the Auto Alliance Review of Fuel Economy Standards Misses the Mark,” July 6, 2016, Ceres, https://www.ceres.org/press/blog-posts/auto-alliance-review-misses-the-mark/.

[10] United States Environmental Protection Agency, "Lumped Parameter Model (LPM) for Light-Duty Vehicles," www.epa.gov/regulations-emissions-vehicles-and-engines/lumped-parameter-model-lpm-light-duty-vehicles.

[11] United States Environmental Protection Agency, “Computer Simulation of Light-Duty Vehicle Technologies for Greenhouse Gas Emission Reduction in the 2020-2025 Timeframe,” EPA-420-R-11-020, December 2011.

[12] Green Car Congress, "Toyota implements Atkinson cycle in non-hybrid ESTEC engine; up to 38% thermal efficiency and improved fuel economy", June 2014.

[13] Sovran, G. and Blaser, D., “A Contribution to Understanding Automotive Fuel Economy and Its Limits,” SAE Technical Paper 2003-01-2070, 2003, doi:10.4271/2003-01-2070.

[14] Sovran, G. and Blaser, D., “Quantifying the Potential Impacts of Regenerative Braking on a Vehicle's Tractive-Fuel Consumption for the U.S., European, and Japanese Driving Schedules,” SAE Technical Paper 2006-01-0664, 2006, doi:10.4271/2006-01-0664.

[15] Sovran, G., “The Impact of Regenerative Braking on the Powertrain-Delivered Energy Required for Vehicle Propulsion.,” SAE Technical Paper 2011-01-0891, 2011, doi:10.4271/2011-01-0891.

[16] Sovran, G., "Revisiting the Formulas for Tractive and Braking Energy on the EPA Driving Schedules," SAE Int. J. Passeng. Cars - Mech. Syst. 6(1):2013, doi:10.4271/2013-01-0766.

[17] Hochgraf, C. and Duoba, M., "What if the Prius Wasn't a Hybrid? What if the Corolla Were? An Analysis Based on Vehicle Limited Fuel Consumption and Powertrain and Braking Efficiency," SAE Technical Paper 2010-01-0834, 2010, doi:10.4271/2010-01-0834.

[18] Hochgraf, C., "2010 North American Light Duty Vehicle Assessment: The Ten Most Efficient Powertrains, The Ten Lowest Energy Consumption Chassis," SAE Technical Paper 2011-01-0889, 2011, doi:10.4271/2011-01-0889.

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December 30, 2016

Christopher Lieske
Office of Transportation and Air Quality (OTAQ)
Assessment and Standards Division (ASD)
Environmental Protection Agency
2000 Traverwood Drive
Ann Arbor, MI 48105

Submitted electronically to http://www.regulations.gov and via electronic mail

Docket ID No. EPA-HQ-OAR-2015-0827

Alliance of Automobile Manufacturers Comments on Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation

Dear Mr. Lieske,

I am submitting the enclosed comments and associated attachments on behalf of the Alliance of Automobile Manufacturers (Alliance)[1] in response to the subject Proposed Determination[2] and its associated Technical Support Document.[3]

The Alliance strenuously objects to the Proposed Determination, both procedurally and substantively and requests that EPA withdraw its premature Proposed Determination and recommit to a meaningful, comprehensive, and responsive Midterm Evaluation. Our request rests upon the following principles:

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[1] The Alliance of Automobile Manufacturers, is an association representing 12 manufacturers of cars and light trucks. Alliance members are BMW Group, FCA US LLC, Ford Motor Company, General Motors Company, Jaguar Land Rover, Mazda, Mercedes-Benz USA, Mitsubishi Motors, Porsche Cars North America, Toyota, Volkswagen Group of America, and Volvo Car USA. For more information, please visit: www.autoalliance.org.

[2] "Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards under the Midterm Evaluation." U.S. Environmental Protection Agency. EPA-420-R-16-020, November 2016.

[3] "Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards under the Midterm Evaluation: Technical Support Document." Assessment and Standards Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency. EPA-420-R-16-021, November 2016.

- EPA's premature action conflicts with its long-standing commitment to a single national program;
- The Proposed Determination suffers from multiple, serious, procedural and substantive technical flaws; and
- The Midterm Evaluation process bypassed critical procedural requirements.

Alliance members' concerns are exemplified in the Proposed Determination and associated Technical Support Document: Not a single conventional MY 2016 vehicle currently meets the MY 2025 standards, including vehicles with the advanced conventional technologies described by EPA as enabling manufacturers to meet the future standards.

Your consideration of these comments and attachments is appreciated. If you have any questions on this matter, please contact me at (248) 357-4717, extension 103 or at MHartrick@autoalliance.org.

Sincerely,

Michael Hartrick

Michael Hartrick
Director of Fuel Economy & Climate
Alliance of Automobile Manufacturers

Cc.

Bill Charmley, U.S. Environmental Protection Agency
Michael McCarthy, California Air Resources Board
Robin Moran, U.S. Environmental Protection Agency
Michael Olechiw, U.S. Environmental Protection Agency
Jim Tamm, National Highway Traffic Safety Administration
Rebecca Yoon, National Highway Traffic Safety Administration

Alliance of Automobile Manufacturers
Comments on Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards Under the Midterm Evaluation
December 30, 2016

Introduction

The Alliance of Automobile Manufacturers[1] ("Alliance") hereby submits comments on the Environmental Protection Agency ("EPA") Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards under the Midterm Evaluation[2] ("Proposed Determination") and the associated Technical Support Document[3] ("TSD").

The Alliance strenuously objects to the Proposed Determination, both procedurally and substantively and requests that EPA withdraw its premature Proposed Determination and recommit to a meaningful, comprehensive, and responsive Midterm Evaluation.[4] There is no legitimate reason to accelerate the Midterm Evaluation process by issuing a Final Determination more than one year in advance of the April 2018 endpoint described in regulation.[5]

Alliance members' concerns are exemplified by Appendix C of the TSD: Only 5% of the MY 2016 vehicle models compliant with the future MY 2022 standards are not hybrid, plug-in electric, or fuel cell vehicles. Not a single conventional vehicle, including vehicles with turbocharged-downsized engines, Atkinson cycle engines, advanced transmissions, stop/start, variable valve timing, direct injection, and other non-hybrid technologies, currently meets the MY 2025 standards. Even when additional credits are assumed at the levels estimated in the original MY 2017-2025 final rule,[6] only hybrid, plug-in electric and fuel cell vehicles meet the MY 2025 standards.

Because EPA has given interested parties only 24 days from the date of *Federal Register* publication to respond to over a thousand pages of complex analysis, these comments are necessarily limited to providing an overview of the Alliance's concerns. However, the Alliance

[1] Alliance members are BMW Group, FCA US LLC, Ford Motor Company, General Motors Company, Jaguar Land Rover, Mazda, Mercedes-Benz USA, Mitsubishi Motors, Porsche Cars North America, Toyota, Volkswagen Group of America and Volvo Car USA. For more information, please visit: www.autoalliance.org.

[2] "Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards under the Midterm Evaluation." U.S. Environmental Protection Agency. EPA-420-R-16-020, November 2016.

[3] "Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards under the Midterm Evaluation: Technical Support Document." Assessment and Standards Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency. EPA-420-R-16-021, November 2016.

[4] If the Proposed Determination is not withdrawn by EPA, a meaningful, comprehensive and responsive Midterm Evaluation should entail a notice and comment period of at least 120 days on the Proposed Determination alone.

[5] *See* 40 C.F.R. 86.1818-12(h).

[6] 77 Fed. Reg. 62,624 (Oct. 15, 2012).

hereby renews its request to meet with EPA technical staff to discuss these comments and to provide any additional detail that EPA considers necessary to properly consider the Alliance's concerns.

The Alliance supports reducing greenhouse gas ("GHG") emissions associated with the operation of light-duty vehicles, but believes that reductions must be made in a manner that accounts for market realities. In October 2012, when EPA and the National Highway Traffic Safety Administration ("NHTSA") initially set GHG standards for model year ("MY") 2022-2025 vehicles, the MY 2025 endpoint was thirteen years in the future and the standards that EPA set were remarkably ambitious. EPA expected that the rule would create a transformed vehicle fleet capable of achieving an average 54.5 miles per gallon equivalent[7] depending on fleet mix, compared to an average 30.9 miles per gallon equivalent when the MY 2017-2025 standards were promulgated in 2012.[8] Less than 3.5% of today's light-duty vehicle production meets the MY 2025 standards.[9] EPA further anticipated that new technology costing $2,748 per vehicle would trigger this sea change in fuel economy starting with MY 2012.[10] This may well be the most consequential EPA decision for the auto industry since the modern Clean Air Act ("CAA") was enacted in 1970. Compliance with EPA's GHG standards for model years 2012-2025 was estimated to cost industry and consumers over $200 billion.[11] Thousands of jobs in the auto industry are on the line and EPA's mandated emissions reductions will dramatically affect the design, technology, and materials of virtually every new car going forward.

No agency had ever set standards for GHG emissions or fuel economy so far into the future, or with such tremendous consequences across an entire critical industry. EPA, NHTSA and all stakeholders understood in 2012 that no one could accurately project the circumstances impacting the technological and economic practicability and feasibility of these standards all the way out through MY 2025. Accordingly, EPA and NHTSA committed to a robust Midterm Evaluation process whereby the agencies would take a fresh look at whether to retain the MY 2022-2025 standards based on new technological developments, customer demand, market conditions and public input.[12] The agencies agreed to complete the Midterm Evaluation by April 2018.

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[7] 77 Fed. Reg. 62,627 (Oct. 15, 2012).

[8] "Greenhouse Gas Emission Standards for Light-Duty Vehicles: Manufacturer Performance Report for the 2015 Model Year." U.S. Environmental Protection Agency. EPA-420-R-16-014, November 2016. 53. (Fleet total compliance value of 288 grams per mile converted to miles per gallon with conversion factor of 8,887 grams CO_2 per gallon gasoline for consistency with prior 54.5 miles per gallon value.)

[9] "Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2016." U.S. Environmental Protection Agency. EPA-420-R-16-010, November 2016. 118.

[10] 75 Fed. Reg. 25,348 (May 7, 2010) (Table I.C.2-6.); 77 Fed. Reg. 62,775 (Oct. 15, 2012). (Table III-8.).

[11] 75 Fed. Reg. 25,346 (May 7, 2010) (Table I.C.2-1); 77 Fed. Reg. 62,774 (Oct. 15, 2012). (Table III-6, Incremental Vehicle Program Cost).

[12] *See, e.g.,*76 Fed. Reg. 48,760 (Aug. 9, 2011) ("Mid-Term Review"); 76 Fed. Reg. 74,879 (December 1, 2011) ("Mid-Term Evaluation"); 77 Fed. Reg. 62,633 (Oct. 15, 2012); 40 C.F.R. § 86.1818-12(h).

The auto industry has always viewed the Midterm Evaluation as central to the viability and validity of the MY 2022-2025 standards. Virtually all auto manufacturers supported EPA's establishment of MY 2022-2025 standards back in 2011-2012. But manufacturers did so on the condition that the Midterm Evaluation comprehensively reassess the appropriateness of those standards and address the uncertainties inherent in long-term projections.[13]

EPA is now poised to complete the Midterm Evaluation, but has executed an accelerated and flawed assessment in a manner incompatible with the "collaborative, data-driven, and transparent process" that EPA promised.[14] In this comment letter, the Alliance highlights three of the most serious shortcomings, any one of which warrants invalidation of EPA actions upon judicial review.

First, EPA's Midterm Evaluation process has violated critical procedural safeguards at every turn, denying the public and stakeholders of a meaningful opportunity to comment on EPA's analysis. EPA completed the first stage of the Midterm Evaluation—issuance of a Draft Technical Assessment Report[15] ("Draft TAR")—in July 2016, but provided an inadequate period for interested parties to comment upon that 1,200-page document. EPA denied our request for extension to the comment period, then promised further dialogue and consideration after the Draft TAR comment window closed, but did not fulfill that commitment.

Instead, on November 30, 2016, EPA unexpectedly posted on its website a Proposed Determination that the MY 2022-2025 emissions standards stay unchanged, produced almost a thousand additional pages of analysis, and informed interested parties that they had only until December 30, 2016, to comment. EPA did not even publish the Proposed Determination in the *Federal Register* until December 6, 2016—resulting in an astonishingly short and manifestly inadequate 24-day comment period spanning a major national holiday. Worse still, EPA provided this extraordinarily brief window for comment after a long-standing public representation that EPA would not issue the Proposed Determination until mid-2017. Relying on those representations, the industry commissioned complex studies, which are critical to the Proposed Determination and will not be complete by the close of the comment period on December 30, 2016. EPA's analysis also rests upon the legally incorrect premise that the Proposed Determination is merely an adjudication, not a rulemaking, and therefore need not comply with rulemaking requirements. In addition, the Agency has failed, as required for CAA rulemaking, to afford interested parties a public hearing on its reassessment of the MY 2022-

[13] *See, e.g.*, 77 Fed. Reg. 62,636; *id.* at 62,652; Letter from Alan Mulally, President and Chief Executive Officer, Ford Motor Company to The Honorable Ray LaHood, Secretary, U.S. Department of Transportation and to The Honorable Lisa Jackson, Administrator, U.S. Environmental Protection Agency, July 29, 2011, https://www.epa.gov/sites/production/files/2016-10/documents/ford-commitment-ltr.pdf. Accessed December 5, 2016.

[14] *E.g.*, 81 Fed. Reg. 49,219 (July 27, 2016); 77 Fed. Reg. 62,784 (Oct. 15, 2012).

[15] "Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025." U.S. Environmental Protection Agency, National Highway Traffic Safety Administration, California Air Resources Board. EPA-420-D-16-900, July 2016.

2025 emissions standards; there is no indication in the Proposed Determination that a public hearing is planned. By failing to submit its determination for routine Office of Management and Budget ("OMB") review, EPA also has declined to follow its standard procedure for such major actions.

Second, EPA has now repudiated the central premise of the Midterm Evaluation: that EPA and NHTSA would create a single, harmonized national GHG and fuel economy program. EPA had repeatedly committed to issuing its Proposed Determination as to whether to retain or amend MY 2022-2025 vehicle emissions standards at the same time as NHTSA issued a Notice of Proposed Rulemaking for MY 2022-2025 fuel economy standards. EPA also codified this commitment in its own regulations. *See* 40 C. F. R. § 86.1818-12(h). EPA's commitment was supposed to ensure that EPA and NHTSA closely coordinated to mitigate discrepancies in their analyses of costs, technology, pathways, and other critical features of the GHG/fuel economy program, so that industry and consumers would benefit from a sensible and predictable regulatory scheme.

EPA has now discarded that commitment by issuing its Proposed Determination at least six months in advance of when NHTSA will likely issue its proposed fuel economy standards. NHTSA's eventual proposed rule may substantially differ from EPA's determination—or NHTSA may feel unduly constrained to harmonize its proposal with EPA's prior determination regardless of countervailing facts and analysis. There is no way for EPA to have discharged its regulatory obligation to conduct the Midterm Evaluation by assessing "[t]he impact of the [GHG] emission standards on [NHTSA's] Corporate Average Fuel Economy standards and a national harmonized program."[16] Meanwhile, interested parties have spent considerable time and effort coordinating with both agencies under the assumption that the agencies were harmonizing as planned, and are now in the untenable position of having to comment on the Proposed Determination based on data from only EPA, without being able to review and assess NHTSA's data updates or determinations. This undertaking bears no resemblance to the coordinated effort that the agencies, stakeholders, and the public envisioned.

Third, EPA's conclusion that the standards should stay unchanged rests upon a host of problematic assumptions and technical analyses. Recent developments underscore that the MY 2022-2025 standards may not be appropriate or achievable with the technology mix suggested by EPA. It is expected that more technology will be needed which will add more costs to vehicles. Higher costs will further exacerbate consumer acceptance of future vehicles, especially with the current and forecasted low fuel prices through the MY 2022-2025 timeframe. EPA's analysis fails to satisfy important criteria that EPA itself imposed. And while stakeholders publicly provided input on problems with EPA's analysis after EPA issued its Draft TAR, EPA has ignored or dismissed much of those concerns, and continues to rely on unsound reasoning and flawed data.

The Alliance thus asks EPA to withdraw its premature Proposed Determination and to recommit to a meaningful, comprehensive, and responsive Midterm Evaluation. There is no

[16] 40 C. F. R. § 86.1818-12(h)

legitimate reason to accelerate this process. EPA is not required to issue a final determination until April 2018. As EPA noted when promulgating the 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards ("2012 Rule"),[17] "environmental and consumer organizations express[ed] concerns" that "the mid-term evaluation . . . could occur too early, before reliable data on the new standards is available."[18] Experience has borne out that concern: reliable data are still elusive, critical studies are not yet done, and EPA's own analysis acknowledges its incompleteness. EPA's sudden about-face to complete the Midterm Evaluation on an abbreviated timetable raises the specter that EPA is rushing to judgment solely to hinder the incoming administration. The Alliance urges EPA to reverse course to avoid the appearance of an agency uninterested in a full, open, and fair consideration of all data and information bearing upon emissions standards that will profoundly affect the future of the auto industry.

The Midterm Evaluation Process Bypassed Critical Procedural Requirements

1. The 60-Day Comment Period on the 1,200-Page Draft TAR Was Insufficient.

EPA failed to provide enough time for stakeholders and the public to comment on the Draft TAR and that procedural defect has undercut every ensuing step of the Midterm Evaluation process. The Draft TAR "inform[s] EPA's determination on the appropriateness of the GHG standards and . . . inform[s] NHTSA's rulemaking for the CAFE standards for MY 2022-2025."[19] EPA regulations accordingly required "[p]ublic comment on the draft [TAR]" and for EPA to consider those comments in evaluating the MY 2022-2025 standards.[20]

Yet, when issuing the Draft TAR, EPA and NHTSA deprived stakeholders of the opportunity meaningfully to comment on this critical document. On July 27, 2016, EPA and NHTSA published the Draft TAR in the *Federal Register*; it included more than 1,200 pages and incorporated dozens of newly available separate studies. But EPA and NHTSA provided for only a 60-day comment period, even though the timing of the Draft TAR's release could have allowed for a more generous comment period without endangering the regulatory deadlines for the Midterm Evaluation.[21] And EPA and NHTSA rejected requests from the Alliance and others to extend the comment period to 120 days.[22]

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[17] 77 Fed. Reg. 62,624 (Oct. 15, 2012).

[18] *Id.* at 62,652.

[19] 77 Fed. Reg. 62,784 (Oct. 15, 2012).

[20] 40 C.F.R. § 86.1818-12(h)(2)(ii).

[21] *See* 81 Fed. Reg. 49,217 (Jul. 27, 2016).

[22] Letter from Chris Nevers, Vice President, Environmental Affairs, Alliance of Automobile Manufacturers to Chris Lieske, U.S. Environmental Protection Agency, Rebecca Yoon, National Highway Traffic Safety Administration, and Michael McCarthy, California Air Resources Board (August 1, 2016); Docket ID EPA-HQ-OAR-2015-0827-0928 and NHTSA-2016-0068-0022.

The Alliance and other stakeholders thus lacked sufficient time to review and comment on fundamental issues, such as EPA's modeling efforts and EPA's questionable projections of consumer acceptance.[23] EPA and NHTSA effectively acknowledged as much by promising to "continue to consider new data and information that comes to light beyond the Draft TAR" and to "make every effort to consider public comments submitted after the close of the comment period."[24] The Alliance thus expected that the industry would continue to conduct analyses bearing on the complex technical issues underpinning the Draft TAR for at least several more months. Instead, EPA has now magnified the problems with the short comment period for the Draft TAR by issuing an unexpectedly early Proposed Determination and providing only 24 days from publication in the *Federal Register* for comment.

2. EPA's Unprecedented 24-Day Comment Period on the Proposed Determination Is Manifestly Inadequate.

EPA abruptly changed course on November 30, 2016, and issued a 268-page Proposed Determination, along with a 719-page TSD. The Proposed Determination incorporates over 1.5 gigabytes of new modeling data, and contains a wealth of new data and analysis. Even duplicative material requires significant review and analysis, because EPA appears to have reasserted, without adequate explanation, various conclusions from the Draft TAR that commenters rebutted. Commenters must thus make further judgments about whether to bolster their prior points and speculate as to why EPA apparently rejected them. In addition, determining what EPA has responded to and what it has disregarded is quite time-consuming. Moreover, even before this, EPA had repeatedly committed to providing stakeholders with notice of the Proposed Determination and a meaningful opportunity to comment on it, and indeed committed to seeking such comment in its regulations.[25] Yet EPA issued the Proposed

[23] *See* Testimony of Mitch Bainwol, *Hearing on Midterm Review & Update on CAFE Program*, House Comm. on Energy & Commerce (Sept. 22, 2016).

[24] Letter from Janet G. McCabe, U.S. Environmental Protection Agency Acting Assistant Administrator and Paul A. Hemmersbaugh, Chief Counsel, National Highway Traffic Safety Administration, to Chris Nevers, Vice President, Environmental Affairs, Alliance of Automobile Manufacturers and Julia Rege, Director, Environmental and Energy Affairs, Association of Global Automakers (Aug. 22, 2016).

[25] *See* 40 C.F.R. § 86.1818-12(h)(2) (requiring public comment); 77 Fed. Reg. at 62,784 (Oct. 15, 2012) ("Up to date information will be developed and compiled for the evaluation, through a collaborative, robust and transparent process, including public notice and comment."); *id.* at 62,786 ("EPA will determine the appropriate course to follow based on all of the information, evidence, and views in front of it, including those provided during public notice and comment."); 81 Fed. Reg. 87,927 (Dec. 6, 2016) ("EPA will again consider public comments received on the Proposed Determination as it proceeds with the final step in the Midterm Evaluation, a Final Determination regarding the appropriateness of the MY 2022–2025 standards."); *id.* at 87,928 ("EPA requests comment on the Proposed Determination."); EPA, *Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas (GHG) Emissions Standards for Model Years 2022-2025*, https://www.epa.gov/regulations-emissions-vehicles-and-engines/midterm-evaluation-light-duty-vehicle-greenhouse-gas-ghg ("Step 2: EPA Administrator makes a Proposed Determination with opportunity for public comment."); Letter from Janet G. McCabe, Acting Assistant Administrator, EPA, and Paul A. Hemmersbaugh, Chief Counsel, NHTSA, to Chris Nevers, Vice President, Environmental Affairs, The Alliance of Automobile Manufacturers, and Julia Rege, Director, Environmental and Energy Affairs, Association of Global Automakers, EPA-HQ-OAR-2015-0827-1129 (Aug. 22, 2016) ("The Draft TAR and the public comment period are just the first step in the mid-term evaluation process, and there will be additional opportunities for public

Footnote continued on next page

Determination with no advance warning beyond morning calls to some industry representatives. Not only that: When posting the Proposed Determination on EPA's website, EPA informed stakeholders that they had only 30 days from the date of this internet posting—until December 30, 2016—to comment.[26] EPA took that position even though EPA did not publish the Proposed Determination in the *Federal Register* until December 6, 2016.[27] And EPA insisted on that abbreviated time window despite the Alliance's request to extend the comment period to 120 days.[28] This 24-day comment period is unprecedented in its brevity for such a complex and consequential action and clearly fails without good cause to provide interested parties with a sufficient opportunity to weigh in on the many complex issues underpinning EPA's Proposed Determination.

Only publication of proposed agency action in the *Federal Register* constitutes legally adequate notice.[29] The D.C. Circuit "has never found that internet notice is an acceptable substitution for publication in the *Federal Register*."[30] Indeed, EPA itself previously acknowledged this point—and every other recent comment period on EPA action has started from the date of publication in the *Federal Register*.[31] Thus, EPA has, at most, afforded interested parties a mere *24 days* in which to comment upon nearly a thousand pages of agency analysis and over 1.5 gigabytes of electronic modeling information (in compressed format)[32] on

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Footnote continued from previous page
input in the future. Under its regulations, EPA must seek public comment on a Proposed Determination regarding the appropriateness of the model year (MY) 2022-2025 standards.")

[26] *See* EPA, Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas (GHG) Emissions Standards for Model Years 2022-2025, https://www.epa.gov/regulations-emissions-vehicles-and-engines/midterm-evaluation-light-duty-vehicle-greenhouse-gas-ghg. (Accessed December 23, 2016.)

[27] *See* 81 Fed. Reg. 87,927 (Dec. 6, 2016).

[28] Letter from Mitch Bainwol, President and CEO of Alliance of Automobile Manufacturers, to Gina McCarthy, EPA Administrator, and Christopher Lieske, Office of Transportation and Air Quality Assessment and Standards Division, Dec. 8, 2016, at 7.

[29] *See* 5 U.S.C. § 553(b)-(c) (agencies must publish "[g]eneral notice of [the] proposed rule . . . in the *Federal Register*, unless persons subject thereto are named and either personally served or otherwise have actual notice thereof in accordance with law," and the opportunity to comment occurs only "[a]fter notice required by this section."); *accord* 42 U.S.C. § 7607(d)(5)(3) ("In the case of any rule to which this subsection applies, notice of proposed rulemaking shall be published in the *Federal Register*"). Even if the Proposed Determination did not qualify as a rule, there is no reason why notice short of publication in the *Federal Register* would adequately inform interested parties of other types of agency action.

[30] *Util. Solid Waste Activities Grp. v. E.P.A.*, 236 F.3d 749, 754 (D.C. Cir. 2001).

[31] *See, e.g.*, Approval of California Air Plan, 81 Fed. Reg. 89,407 (Dec. 12, 2016) (comments due Jan. 11, 2017); Outer Continental Shelf Air Regulations, 81 Fed. Reg. 89,418 (Dec. 12, 2016) (comments due Jan. 11, 2017); Proposed CERCLA Section 122(h) Cost Recovery Settlement for the Columbia Smelting and Refining Works Site, 81 Fed. Reg. 89,459 (Dec. 12, 2016) (comments due Jan. 11, 2017); Allocations of Cross-State Air Pollution Rule Allowances from New Unit Set-Asides for 2016 Control Periods, 81 Fed. Reg. 89,035 (Dec. 12, 2016) (comments due Jan. 11, 2017).

[32] *See* "Advanced Light-Duty Powertrain and Hybrid Analysis (ALPHA) Tool – ALPHA V2.1 Calibration Samples" U.S. Environmental Protection Agency. https://www.epa.gov/regulations-emissions-vehicles-and-engines/advanced-light-duty-powertrain-and-hybrid-analysis-alpha. (Accessed December 23, 2016)

one of the most consequential EPA rules ever for the automobile industry. And this 24-day period falls during a major holiday period during which many automobile manufacturers are closed for seven days within the comment period provided and critical staff are on holiday and vacation, which will further diminish stakeholders' ability to evaluate and comment upon the Proposed Determination. In effect, EPA has provided less than three weeks for comments on a key and last step before a final determination to provide input in the Midterm Evaluation process.

This is a woefully inadequate amount of time for the public, stakeholders, and the Alliance's members to understand the agency's technical model updates, assess the new conclusions, and respond to the request for comment. The Clean Air Act requires EPA to publish notice of a proposed rule in the *Federal Register* and to provide more than 30 days for comment on any rule regulating air pollution pursuant to CAA Section 202, which is the provision EPA invokes to justify the Midterm Evaluation.[33] And while the Administrative Procedure Act does not specify a minimum time for submission of comments in an informal rulemaking, the Administrative Conference generally recommends at least 60 days because 30 days is considered "an inadequate time to allow people to respond to proposals that are complex or based on scientific or technical data."[34]

EPA's extraordinarily abbreviated 24-day window for comment on the Proposed Determination is especially striking given that EPA has provided far longer comment periods at every prior stage of its evaluation of MY 2022-2055 vehicle emissions. EPA provided 60 days to comment on the 2012 Rule.[35] EPA later extended the comment period on the 2012 Rule by an additional 14 days (providing a 74 day comment period).[36] The 24-day comment period for the Proposed Determination is also less than half as long as the 60-day comment period applicable to comments on the Draft TAR, even though EPA described the Draft TAR as merely "a technical report, not a decision document" like the Proposed Determination.[37] EPA's unexpected decision to provide just 24 days of comment on the Proposed Determination is unjustifiable given that the 60-day comment period on the Draft TAR proved inadequate and prompted the Agencies to promise stakeholders further opportunity for comment. Nor has EPA provided such a short comment period for other recent and substantial agency actions. Quite the contrary: before the Proposed Determination, EPA provided between 31 and 102 days for comments on all of EPA's

[33] *See* 42 U.S.C. § 7607(d)(3) and (5) (requiring EPA to publish notice of proposed rule in *Federal Register* and to keep record open for additional 30 days after holding a public hearing on proposed rule during comment period); *see also* 77 Fed. Reg. 62,786 (stating that EPA's authority to conduct the Midterm Evaluation comes from Section 202(a)).

[34] *Petry v. Block*, 737 F.2d 1193, 1201 & n.18 (D.C. Cir. 1984) (referring to Administrative Conference of the United States, A Guide to Federal Agency Rulemaking 124 (1983)).

[35] *See* 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, 76 Fed. Reg. 74,853 (Dec. 1, 2011) (comments due Jan. 30, 2012).

[36] See 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards; Extension of Comment Period, 77 Fed. Reg. 2,028 (Jan. 13, 2012).

[37] *See* EPA Draft TAR at 1-2.

consequential proposed actions in 2016.[38] Major or complicated EPA rules have routinely had comment periods of at least 90 to 120 days.[39] With its lengthy technical analyses and extensive modeling, this Proposed Determination is an extremely complex rule based on scientific and technical data.

On December 22, 2016, EPA denied, in writing, the Alliance's request to either withdraw the Proposed Determination or extend the comment period.[40] EPA's rationale essentially is that the Agency continues to believe the Proposed Determination and the "30-day" comment period remain appropriate. As these comments explain in considerable detail, the Alliance strongly disagrees.

3. EPA Has Undermined the Integrity of the Notice and Comment Process by Misrepresenting the Timeframe for the Midterm Evaluation.

EPA further undermined the notice-and-comment process by inducing stakeholders to rely on EPA's repeated representations that the Proposed Determination would not issue until mid-2017 and then drastically pulling ahead of this schedule without notice. Indeed, until

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[38] *See, e.g.*, Approval of California Air Plan, 81 Fed. Reg. 89,407 (Dec. 12, 2016) (comments due Jan. 11, 2017); Outer Continental Shelf Air Regulations, 81 Fed. Reg. 89,418 (Dec. 12, 2016) (comments due Jan. 11, 2017); Proposed CERCLA Section 122(h) Cost Recovery Settlement for the Columbia Smelting and Refining Works Site, 81 Fed. Reg. 89,459 (Dec. 12, 2016) (comments due Jan. 11, 2017); Allocations of Cross-State Air Pollution Rule Allowances from New Unit Set-Asides for 2016 Control Periods, 81 Fed. Reg. 89,035 (Dec. 12, 2016) (comments due Jan. 11, 2017); Proposed Consent Decree, Clean Air Act Citizen Suit, 81 Fed. Reg. 89,0894 (Dec. 9, 2016) (comments due Jan. 9, 2016); Second External Review Draft Integrated Science Assessment for Sulfur Oxides-Health Criteria, 81 Fed. Reg. 89,097 (Dec. 9, 2016) (comments due Mar. 20, 2017); Interstate Transport of Fine Particulate Matter: Revision of Federal Implementation Plan Requirements for Texas, 81 Fed. Reg. 78,954 (Nov. 10, 2016) (original comment period 32 days), *modified by* 81 Fed. Reg. 88,636 (Dec. 8, 2016) (extending comment period to Jan. 9, 2017); Approval of Air Quality State Implementation Plans; Nevada; Infrastructure Requirements To Address Interstate Transport for the 2008 Ozone NAAQS, 81 Fed. Reg. 81 Fed. Reg. 87,857 (Dec. 6, 2016) (comments due Jan. 5, 2017); Proposed Agreement and Order on Consent for Certain CERCLA Response Activities by Tenant as Bona Fide Prospective Purchaser, 81 Fed. Reg. 87,934 (Dec. 6, 2016) (comments due Jan. 5, 2017); Air Plan Disapproval; AL; Prong 4 Visibility for the 2008 8-Hour Ozone Standard, 81 Fed. Reg. 87,503 (Dec. 5, 2016) (comments due Dec. 27, 2016); Revisions to the Source-Specific Federal Implementation Plan for Four Corners Power Plant, Navajo Nation, 81 Fed. Reg. 86,988 (Dec. 2, 2016) (comments due Jan. 3, 2017). The only exception was EPA's simple rejection of an Alabama Air Plan proposal, which EPA issued in early December 2016. *See* Air Plan Disapproval; AL; Prong 4 Visibility for the 2008 8-Hour Ozone Standard, 81 Fed. Reg. 87,503 (Dec. 5, 2016) (comments due Dec. 27, 2016)

[39] *See, e.g.*, Federal Plan Requirements for Greenhouse Gas Emissions From Electric Utility Generating Units Constructed on or Before January 8, 2014, 80 Fed. Reg. 64,965 (Oct. 23, 2015) (91 days); Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings, 80 Fed. Reg. 4155 (Jan. 26, 2015), *modified by* 80 Fed. Reg. 22,964 (Apr. 24, 2015) (extending comment period to 120 days); Regulating Greenhouse Gas Emissions Under the Clean Air Act, 73 Fed. Reg. 44,353 (July 30. 2008) (120 days); Approaches to an Integrated Framework for Management and Disposal of Low-Activity Radioactive Waste, 68 Fed. Reg. 65,119 (Nov. 18, 2003) (121 days);

[40] Letter to Mitch Bainwol, President and CEO, Alliance of Automobile Manufacturers from Janet McCabe, Acting Assistant Administrator, U.S. Environmental Protection Agency (Dec. 22, 2016); Docket ID EPA-HQ-OAR-2015-0827-6006.

recently, EPA posted the following timeline on its website, showing the Proposed Determination in mid-2017:[41]

EPA deleted this timeline from its website on approximately November 30, 2016. EPA also repeatedly used the same timeline, with the mid-2017 date for the Proposed Determination, in numerous communications with stakeholders.[42] EPA planned that the Proposed Determination would issue at the same time as NHTSA initiated proposed rulemaking for the Corporate Average Fuel Economy (CAFE) standards, as set forth in the 2012 Final Rule.[43] By statute, NHTSA cannot issue standards for more than five years at a time.[44] Assuming a six-month period between the NPRM and the Final Rule, the comment period for the NHTSA's

[41] U.S. Environmental Protection Agency, Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas (GHG) Emissions Standards for Model Years 2022-2025, https://www.epa.gov/regulations-emissions-vehicles-and-engines/midterm-evaluation-light-duty-vehicle-greenhouse-gas-ghg#schedule (Accessed November 29, 2016)

[42] *See, e.g.*, EPA, Light-Duty Vehicle Greenhouse Gas Standards: 2025 and Beyond 24 (Sept. 17, 2015), available at http://www.epa.gov/sites/production/files/2016-10/documents/grundler-sae-naipc-2015-09-17-presentation.pdf; EPA, *Light-Duty Vehicle Greenhouse Gas Standards: Center for Automotive Research Management Briefing Seminar* 20 (Aug. 4, 2015), *available at* https://www.epa.gov/sites/production/files/2016-10/documents/grundler-car-mgmt-seminar-2015-08-04.pdf; Letter from Janet G. McCabe, Acting Assistant Administrator, EPA, and Mark R. Rosekind, Administrator, NHTSA, to Rep. Fred Upton, Chairman, H. Comm. on Energy & Commerce (June 2010, 2016) ("While the EPA regulations do not establish a deadline for the Proposed Determination, EPA anticipates that it will be issued in 2017.").

[43] EPA, Light-Duty Vehicle Greenhouse Gas Standards: 2025 and Beyond, supra, at 18; EPA, Light-Duty Vehicle Greenhouse Gas Standards: Center for Automotive Research Management Briefing Seminar, *supra*, at 15; 81 Fed. Reg. at 49,219 ("In order to align the agencies' proceedings for MYs 2022-2025 and to maintain a joint national program, EPA and NHTSA will finalize their actions related to MYs 2022-2025 standard concurrently."); 77 Fed. Reg. at 62,633 ("In order to align the agencies' proceedings for MYs 2022-2025 and to maintain a joint national program, if the EPA determination is that its standards will not change, NHTSA will issue its final rule concurrently with the EPA determination."); *id.* at 62,652 (same); EPA, Draft TAR 5-180 (July 27, 2016) ("At the time of writing for this Draft Tar, the [vehicle weight reduction feasibility and cost study] is in peer review and will be finalized by the NHTSA NPRM and EPA Proposed Determination in 2017."); Memorandum from Janet G. McCabe, Acting Assistant Administrator, EPA, to Laura. Vaught, Associate Administrator, Office of Policy, EPA, EPA-HQ-OAR-2015-0827-1161 (June 13, 2012) (similar).

[44] *See* 77 Fed. Reg. at 62,627; 49 U.S.C. § 32902(b)(3)(B).

proposed 2022-2025 CAFE standards will last through mid-2017, as confirmed by NHTSA's own projections.[45]

The Alliance took EPA at its word. Auto manufacturers commissioned studies and collected data about the pace of technology, consumer attitudes, and other critical issues on the assumption that this information would need to be available by mid-2017. The Alliance and its members were in the process of preparing additional information for submittal to the Midterm Evaluation docket when we received word that the process was being short-circuited on November 30. EPA's surprise issuance of the Proposed Determination many months early thus caught the industry and other stakeholders by surprise, prejudicing any ability meaningfully to comment.

4. EPA Has Not Justified the Curtailed Comment Period.

EPA has offered no legitimate reason for leading the industry and the public to believe that the process would follow a published timeline, then precipitously abandoning that timeline and accelerating the process. While lead-time is certainly important to the automobile industry, under the 2012 joint final rule, an EPA Final Determination is not due until April 2018, almost 17 months from now. Moreover, MY 2022 is currently about 1,800 days away. No one, least of all the auto industry, has suggested that EPA needs to make an immediate decision or that there is insufficient time to allow several more months for comment. There is more than enough time to allow for several additional months of record development ahead of the issuance of a reissued Proposed Determination, while remaining comfortably ahead of the regulatory deadlines set forth for the Midterm Evaluation. Overriding all of this, EPA's actions suggest that the rushed timetable is dictated by the Agency's apparent desire to finalize the Midterm Evaluation before President Obama leaves office.[46]

5. EPA Mischaracterizes the Proposed Determination as Adjudication.

EPA claims the Proposed and Final Determinations entail no rulemaking and only involve adjudication, and that EPA thus need not follow further procedures designed to ensure public participation and guard against arbitrary agency action.[47] Specifically, EPA contends, if the Midterm Evaluation results in a decision to keep the existing standards as promulgated in the 2012 Final Rule, that determination is "adjudicatory" because no new "policy-type rules or standards" will emerge and "the current regulatory status quo" would be "unchanged and unaltered."[48] EPA's position is legally incorrect and also conflicts with EPA's prior

[45] NHTSA, Midterm Evaluation for Light-Duty CAFE, MTs 2022-2025, https://www.nhtsa.gov/corporate-average-fuel-economy/light-duty-cafe-midterm-evaluation (Accessed Dec. 22, 2016).

[46] Indeed, the day after the election, Administrator McCarthy's memorandum to EPA employees stated that EPA would be "running—not walking—through the finish line of President Obama's presidency," which has been widely interpreted as a push to rush as many final rules out as possible. Bob King and Nick Juliano, *Obama's agencies push flurry of 'midnight' actions*, Politico (Nov. 27, 2016), *available at* http://www.politico.com/story/2016/11/obama-regulations-231820.

[47] EPA Proposed Determination at page 3 n.14.

[48] *Id.*

characterizations of the Midterm Evaluation. EPA cannot reframe the Midterm Evaluation as agency adjudication in order to bypass fundamental procedural protections.

An agency "rule" is "an agency statement of general or particular applicability and future effect designed to implement, interpret, or prescribe law or policy."[49] And when an agency formally reconsiders the basis for a prior rule, the agency's reaffirmation of the rule is a "new promulgation."[50] In other words, by reopening a prior rule and substantively reassessing the rule's validity, the agency has effectively promulgated a new rule—even if the result of the agency's reassessment is that the rule should remain unchanged. *Id.*[51]

EPA's Midterm Evaluation falls squarely within rulemaking. EPA is not simply declining to modify a rule. EPA has instead reopened the administrative record underpinning the MY 2022–2025 standards in the 2012 Rule, added thousands of pages to that record, and has made a proposed decision on the basis of that new record that the same emissions standards are appropriate. Moreover, the regulations governing the Midterm Evaluation require EPA to reassess the MY 2022-2025 standards using the hallmarks of notice-and-comment rulemaking. EPA must, for instance, provide public notice of the Proposed and Final Determinations, open the Proposed Determination to public comment, and respond to those comments in the final decision.[52] Furthermore, as EPA has acknowledged, the Midterm Evaluation record must look like the kind of record associated with rulemaking.[53] Nor is EPA merely adjusting underlying technical standards and resolving new factual issues. Rather, as the Proposed Determination reflects, EPA is reiterating and explaining the rationales behind the precise standards articulated in the 2012 Rule as if the agency were re-promulgating them anew. EPA has thus decided to re-impose particular legal requirements based on new developments and justifications.[54]

EPA's contrary characterization of the Midterm Evaluation as adjudication is untenable.[55] Agency adjudication involves the retrospective resolution of discrete factual disputes between identified parties on a case-by-case basis.[56] But EPA has not confined itself merely to resolving disputed facts in the Midterm Evaluation. Rather, the Proposed Determination applies those

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[49] 5 U.S.C. § 551(4).

[50] *Gen. Motors Corp. v. EPA*, 363 F.3d 442, 449–50 (D.C. Cir. 2004).

[51] *Accord, e.g.*, *Nat'l Mining Ass'n v. Dep't of Interior*, 70 F.3d 1345, 1352 (D.C. Cir. 1995); *Edison Elec. Inst. v. EPA*, 996 F.2d 326, 331–32 (D.C. Cir. 1993); *Pub. Citizen v. Nuclear Reg. Comm'n*, 901 F.2d 147, 150–51 (D.C. Cir. 1990); *Ohio v. EPA*, 838 F.2d 1325, 1328 (D.C. Cir. 1988).

[52] *See* 77 Fed. Reg. 62,784 (Oct. 15, 2012); 40 C.F.R. § 86.1818-12(h)(2).

[53] *See* 77 Fed. Reg. 62, 784 (Oct. 15, 2012) (record for Midterm Evaluation would be "the same kind of record that would be developed and before a court for judicial review of the adoption of standards" and "no less robust than that developed for the initial determination to establish the standards.").

[54] *See* 77 Fed. Reg. 62,785 (Oct. 15, 2012) (though the 2012 rules were final, EPA regulations enshrined the Midterm Evaluation as "a mechanism to evaluate and change [emissions standards] in the future, if appropriate.").

[55] *See* EPA Proposed Determination at 3 n.14.

[56] *See, e.g.*, *United States v. Fla. E. Coast Ry. Co.*, 410 U.S. 224, 245 (1973).

facts to the question of whether prospective legal rules are appropriate for an entire industry.[57] For example, the Proposed Determination "estimates that GHG emission decreases will total nearly 540 million metric tons (MMT) over the lifetimes of MY2022-2025 vehicles."[58] And the Proposed Determination evaluates the vehicle program cost and benefits throughout the entire industry.[59] These are all prospective determinations about the appropriateness of a legislative rule, not a retrospective determination between identified parties.

EPA's position is also self-contradictory. Elsewhere, EPA has asserted that its authority to conduct the Midterm Evaluation derives from Section 202(a) of the CAA.[60] But that provision only concerns the EPA Administrator's authority to promulgate rules regulating air pollutants, and belies EPA's claim that the Midterm Evaluation is pure adjudication.[61,62]

6. <u>EPA Has Failed to Hold Required Hearings on the Proposed Determination.</u>

The Clean Air Act also requires EPA to hold a hearing before issuing a Final Determination in the Midterm Evaluation, yet EPA has also failed to do this. Through Section 307(d) of the CAA, Congress imposed a host of procedural requirements on EPA, including that EPA must hold a hearing where interested persons can comment on proposed rules and that EPA must afford an opportunity for interested persons to submit "rebuttal and supplementary information" to the record for 30 days after the hearing.[63] And Congress clearly applied those requirements to the exact type of agency action at issue here: the "promulgation or revision of regulations under [section 202 of the CAA, 42 U.S.C. § 7521]."[64] Furthermore, the Agencies followed Section 307(d)'s requirements in promulgating the 2012 Rule: they held three public hearings across the country on the 2012 Rule and timed them to ensure that the record would be open for 30 days thereafter.[65] Yet, EPA has scheduled no public hearings on the Proposed

[57] *See* 77 Fed. Reg. 62,784 (Oct. 15, 2012).

[58] EPA Proposed Determination at 25.

[59] *See, e.g.*, EPA Proposed Determination Table IV.13, at 44 (collecting MY Lifetime Costs and Benefits).

[60] *See* 77 Fed. Reg. 62,786 (Oct. 15, 2012).

[61] *See* 42 U.S.C. § 7521(a).

[62] Alternatively, the Proposed Determination constitutes a reconsideration of the MY 2022-2025 standards, thereby triggering the procedural requirements in section 307(d). *See* 42 U.S.C. § 7607(d)(7)(B) (providing that in the event a person objects on the basis of new information that is of "central relevance to the outcome of the rule, the Administrator shall convene a proceeding for reconsideration of the rule and provide the *same procedural rights as would have been afforded had the information been available at the time the rule was proposed*.") (emphasis added). We recognize that EPA has opined that "the mid-term evaluation is not a reconsideration of the standards under [section 307(d)]." 77 Fed. Reg. at 62786. The Alliance believes, however, that the procedural requirements apply regardless of whether stakeholders raise concerns about the rule based on new information, as specified in Section 307(d)(7), or EPA itself agrees up front to revisit the MY 2022-2025 standards with a thorough review based on a new record.

[63] 42 U.S.C. § 7607(d)(5).

[64] *Id.* § 7607(d)(1)(K).

[65] 77 Fed. Reg. 62,624, 62,630 (Oct. 15, 2012).

Determination. EPA has no sound reason to refuse to acknowledge Section 307(d)'s applicability, and its refusal to hold a hearing further underscores the breakdown of the "collaborative, data-driven, and transparent process" that EPA promised.[66]

7. EPA Violated Requirements for Publication in the *Federal Register*.

Proposed EPA rules promulgated under the CAA must comply with Section 307(d)(3) requirements for publication in the *Federal Register*, yet EPA's publication of the Proposed Determination complied with none of them. EPA's notice of the Proposed Determination in the *Federal Register* spans less than two full pages. It includes no summary of "the factual data" on which the Proposed Determination is based, no summary of "the methodology used in obtaining the data and in analyzing the data," and no summary of "the legal interpretations and policy considerations" underlying the Proposed Determination.[67] Nor does it adequately incorporate the full Proposed Determination by reference.[68] And until EPA remedies this error, the Proposed Determination fails to adequately notify the public and industry of its rulemaking activity.[69] In sum, by failing to follow this procedural requirement, EPA has effectively whittled the comment period down even further, exacerbating the already egregious deficiencies in this notice-and-comment process.

8. EPA Should Have Submitted the Proposed Determination for OMB Review.

EPA's failure to submit the Proposed Determination to the Office of Management and Budget (OMB) presents yet another troubling procedural anomaly. Agencies, —including EPA, —have long been required to submit proposed rules to OMB for review, and to refrain from publishing final rules before addressing OMB's comments.[70] Section 307(d)(4)(B)(ii) of the Clean Air Act specifically requires materials submitted to OMB for such review to be included in the rulemaking record.[71] OMB review provides a critical check on agency action by independently assessing the validity of agency assumptions about the costs and benefits of consequential agency action. Indeed, EPA has characterized prior submissions of agency actions for OMB review as "routine."[72] And, notably, EPA submitted the Draft TAR for OMB review

[66] *See* 81 Fed. Reg. 49,219 (July 27, 2016); *see also* 77 Fed. Reg. 62,784 (Oct. 15, 2012).

[67] 42 U.S.C. § 7607(d)(3).

[68] *See* 79 Fed. Reg. 66,267, 66,267 (Nov. 7, 2014); 1 C.F.R. § 51.

[69] *Cf. Husqvarna AB v. EPA*, 254 F.3d 195, 203 (D.C. Cir. 2001).

[70] *See* Exec. Order No. 12,866, 58 Fed. Reg. 51,735 (Sept. 30, 1993); Exec. Order 13,563, 76 Fed. Reg. 3821 (Jan. 21, 2011).

[71] 42 U.S.C. § 7607(d)(4)(B)(ii).

[72] K. Goldberg, *EPA Sends Clean Energy Incentive Proposal to White House*, Law360 (Apr. 27, 2016), *available at* http://www.law360.com/articles/789652/epa-sends-clean-energy-incentive-proposal-to-white-house ("Sending this proposal to OMB for review is a routine step . . . ."); T. Cama, *EPA Sends Methane Leak Rule for Final Review*, The Hill (June 24, 2015), *available at* http://thehill.com/policy/energy-environment/245959-epa-sends-methane-leak-rule-for-final-review (describing OMB review as a "routine step").

six weeks before publishing the Draft TAR in the *Federal Register*.[73] That not only gave OMB time to comment on the Draft TAR but also notified stakeholders that the Draft TAR was forthcoming.

EPA has now changed course and has declined to submit the Proposed Determination for OMB review. That omission is particularly striking because EPA indicated that the TSD accompanying the Proposed Determination serves as the final technical assessment report.[74] Having already submitted the Draft TAR for OMB review, it is virtually unheard of that EPA would not submit the final version for OMB review. Yet EPA has prevented OMB from reviewing EPA's reassessment of what is perhaps the most significant rule in the history of the automobile industry. EPA offers no justification for this abrupt reversal. Rather, it is manifestly apparent that EPA sacrificed this step-to meet a timeline of promulgating the Final Determination before Inauguration Day.

EPA's Premature Action Conflicts with the Long-Standing Commitment to a Single National Program

The 2012 Final Rule preamble stated:

> In order to align the agencies' proceedings for MYs 2022–2025 and to maintain a joint national program, EPA and NHTSA will finalize their actions related to MYs 2022–2025 standards concurrently.[75]

And

> EPA and NHTSA will consult and coordinate in developing EPA's determination on whether the MY2022-2025 GHG standards are appropriate under section 202(a) and NHTSA's NPRM.[76]

The 2012 Final Rule's promise that the agencies would finalize their actions related to the MYs 2022-2025 standards "concurrently" is embodied in the Final Rule regulatory

[73] Memorandum to L. Vaught, Associate Administrator, Office of Policy, EPA, from J. McCabe, Acting Assistant Administrator, EPA (June 13, 2012), *available at* https://www.regulations.gov/document?D=EPA-HQ-OAR-2015-0827-1161.

[74] EPA Proposed Determination at 2.

[75] 77 Fed. Reg. 62,628 (Oct. 15, 2012). As recently as July 27, 2016, the Agencies quoted from this passage and reiterated this promise. *See* 81 Fed. Reg. 49219 (July 27, 2016) (announcing the release of the Draft TAR). Until recently, NHTSA's web site describing the Midterm Evaluation schedule explained that "NHTSA has a statutory obligation to conduct a comprehensive rulemaking in order to establish final CAFE standards for MYs 2022–2025. *The next step in the process after the Draft TAR is to issue a Notice of Proposed Rulemaking (NPRM) in conjunction with EPA's Proposed Determination or NPRM.*" NHTSA, CAFE Fuel Economy Standards and Midterm Evaluation for Light- Duty Vehicles, MYs 2022-2025, *available at* http://www.nhtsa.gov/Laws+&+Regulations/CAFE+-+Fuel+Economy/ld-cafe-midterm-evaluation-2022-25 (accessed March 18, 2016) (emphasis added). As of Dec. 14, 2016, the sentence in italics omits any reference to EPA.

[76] 77 Fed. Reg. 62628 (Oct. 15, 2012).

requirement that, in evaluating the appropriateness of the MY 2022-2025 standards as part of the Midterm Review, EPA "shall consider . . . [t]he impact of the greenhouse gas emission standards on the Corporate Average Fuel Economy standards and a national harmonized program."[77]

The agencies' promise to harmonize also is key to understanding the schedule that EPA and NHTSA developed for the Draft TAR and the deadlines for the Proposed Determination. Specifically, the Draft TAR was to be released "[n]o later than November 15, 2017,"[78] and a determination on whether the standards are appropriate was to be issued "[n]o later than April 1, 2018."[79] These deadlines were designed to allow EPA and NHTSA to coordinate *with respect to NHTSA's rulemaking*, given NHTSA's inability, per statute, to set CAFE standards more than five model years at a time.[80] By unilaterally issuing the Proposed Determination, EPA has ignored its own representation to stakeholders that the agencies would coordinate the Proposed Determination and NHTSA rulemaking on the MY 2022-2025 standards.

In addition, EPA has manifestly failed its obligation to "consider . . . [t]he impact of the greenhouse gas emission standards on the Corporate Average Fuel Economy standards and a national harmonized program." EPA seems to believe that it has fulfilled this obligation merely by making its determination available in advance of NHTSA's rulemaking on the MY 2022-2025 standards.[81] However, under EPA's logic, *any* standards would be justified under 40 C.F.R. § 86.1818-12(h)(1)(vii), as long as NHTSA has notice of the standards in advance of its own rulemaking. EPA has replaced the collaborative process envisioned by the 2012 Final Rule with a rushed, unilateral determination.

EPA's approach compounds the harmonization difficulties that the Alliance and others have already noted. The Draft TAR revealed significant differences between EPA and NHTSA with respect to their analyses of costs, technology pathways and other factors. There are significant differences in the modeling outcomes of both agencies—differences that the Draft TAR attempts to paint as a virtue by asserting that the agencies' "independent analyses complement one another and reach similar conclusions."[82] To the contrary, these differing outcomes indicate that the agencies disagree about how manufacturers are able to comply with the MY 2022-2025 standards. For example, EPA estimates that Ford's cost to comply is $1,385

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[77] 40 C.F.R. § 86.1818-12(h)(1)(vii).

[78] 40 C.F.R. § 86.1818-12(h)(3).

[79] 40 C.F.R. § 86.1818-12(h).

[80] *See* 77 Fed. Reg. 62,691 ("The National Program, of which this final rule is a part, covers 9 model years of standards—2017–2025—but NHTSA is directed by statute to set CAFE standards for ''at least 1, but not more than 5'' model years at a time.") (quoting 49 U.S.C. § 32902(b)(3)(B)).

[81] *See* EPA Proposed Determination at page 53 ("EPA believes that by providing information on our evaluation of the current record and our proposal to retain the current GHG standards for MY2022-2025, we are enabling, to the greatest degree possible, NHTSA to take this analysis and the GHG standards into account in considering the appropriate CAFE standards for MY 2022-2025.")

[82] *See* Alliance Draft TAR Comments, Docket ID EPA-HQ-OAR-2015-0827-4089 at xiii.

per vehicle,[83] while NHTSA estimates $2,878 per vehicle.[84] Also, the agencies differ by 43% in their assessment of the percentage of higher compression ratio, naturally aspirated gasoline engines automakers are expected to deploy to meet the MY 2025 standards.[85] Similarly, the percent of turbocharged and downsized gasoline engines differs by 21%, and the percent of stop-start technology differs by 18%.[86] These are not mere differences in how the automakers might choose to comply. Rather, they are differences in the two agencies' evaluation of the lowest cost approach to compliance; these assessments contradict each other and are incompatible, as the two agencies cannot both be correct.

The Alliance also requested that the agencies take more formal action to harmonize the programs.[87] The Alliance requested that EPA and NHTSA take joint action to (a) include off-cycle credits in fuel economy calculations, (b) revise 40 C.F.R. § 86.1818(k)(5) to provide for more flexible credit management, (c) correct the multiplier for BEVs, PHEVs, FCVs and CNGs, and (d) provide an improved off-cycle credit approval process. The Alliance also requested that NHTSA take a specific action to harmonize the CAFE program with EPA's program, including making the credit transfer definition more consistent with EPA's definitions and adjusting the minimum domestic passenger car standard.[88] EPA's rushed determination now precludes any coordination between the agencies on these important issues.

Finally, EPA's Proposed Determination repeats an error that has dogged the 2012 Final Rule from the start. In failing to estimate the costs of California's zero emission vehicle ("ZEV") mandate[89] ("ZEV Mandate") —a program whose costs have never been fully included in any regulatory analysis—EPA has presented a misleading picture of the costs of the national program. EPA asserts that it should only consider the costs that will result from the standards under review in the Proposed Determination. However, here, where compliance with EPA's GHG regulations presupposes manufacturer compliance with the ZEV mandate, and those costs have never been fully evaluated by any government agency, it is appropriate under EPA's own cost-benefit guidance to take those costs into account.[90] Otherwise, the cost assessment will

[83] EPA Draft TAR at 12-84 (Table 12.102, Ford Cost delta).

[84] *Id.* at 13-89 (Table 13.21, Ford Total Average Cost MY 2025).

[85] *Id.* at ES-10 (Table ES-3, comparing higher compression ratio, naturally aspirated gasoline engine technology penetration modeled for GHG and CAFE compliance).

[86] *Id.* at ES-10 (Table ES-3, comparing GHG and CAFE compliance for turbocharged and downsized gasoline engines and stop-start technologies).

[87] *See* Alliance Draft TAR Comments, Docket ID EPA-HQ-OAR-2015-0827-4089 Attachment 6.

[88] *See id.*

[89] *See* 13 C.C.R. §§ 1962.1 and 1962.2.

[90] *See* National Center for Environmental Economics, Office of Policy, U.S. Environmental Protection Agency, "Guidelines for Preparing Economic Analyses" (December 17, 2010) at 5-9. Cited authority states "[i]f a proposed regulation is expected to increase compliance with a previous rule, the correct measure of the costs and benefits generally excludes impacts associated with the increased compliance. This is because the costs and benefits of the previous rule were presumably estimated in the economic analysis for that rule, and should not be counted again for

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understate the true costs to manufacturers for achieving the future standards. This is particularly important where the costs of the ZEV Mandate are large enough to effectively dictate a particular pathway for achieving compliance at costs that can materially affect the feasibility of achieving the CAFE and GHG standards.[91]

The Proposed Determination Suffers from Multiple, Serious Procedural and Substantive Technical Flaws

1. EPA Has Not Adequately Addressed Alliance Comments on EPA's Interpretation of its Own "Guidelines for Preparing Economic Analyses".

In its comments on the Draft TAR, the Alliance addressed EPA's requirements for preparing economic analyses in the context of its treatment of battery-electric and plug-in hybrid electric vehicles to meet the ZEV Mandate.[92] In responding to the Alliance comments, EPA states that the Alliance comments are mistaken and that there is no issue because the costs and benefits of the vehicles associated with the ZEV Mandate are included in both the reference and control cases.[93] EPA has misunderstood the Alliance comments and has failed to respond substantively. The Draft TAR was clear that EPA included the vehicles in both the reference and control fleets in that analysis. The Alliance comments did not take direct issue with this aspect. Rather, the Alliance objected to EPA's (a) effective inclusion of GHG benefits (i.e. a lowering of other technologies required) at no cost; and (b) failure to consider the cost of the ZEV Mandate at any point in time as related to EPA's own requirements under its own "Guidelines for Preparing Economic Analyses".[94]

The Alliance recommends that EPA address these issues in support of a defensible analysis of actual compliance costs.

2. EPA Dismissed Comments Submitted by the Alliance as Lacking Sufficient Data, and Then Denied Requests for Meetings to Discuss Its Concerns.

At a number of points in the TSD, EPA notes difficulty in understanding or responding to Alliance comments submitted on the Draft TAR due to a lack of sufficient information.[95]

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the proposed rule." Here, no agency (not CARB, not EPA, not NHTSA) has fully estimated the costs of compliance with the ZEV program in all the states in which it applies.

[91] *See generally* Alliance Draft TAR Comments, Docket ID EPA-HQ-OAR-2015-0827-4089 at xi-xii.

[92] *Id.* at xii et seq.

[93] EPA TSD at 1-32.

[94] *See* Alliance Draft TAR Comments, Docket ID EPA-HQ-OAR-2015-0827-4089 at xii, particularly footnotes 30 and 31.

[95] *See, e.g.,* EPA TSD at 2-301 ("[The Alliance] did not share the test conditions…, procedures..., [etc.]"); TSD at 2-307 ("[The Alliance] did not provide sufficient information for EPA to determine with certainty…"); TSD at A-35
Footnote continued on next page

EPA's position that the Alliance failed to provide sufficient detail or context in its comments on the Draft TAR is self-serving and arises from EPA's decision to provide an unreasonably short 60-day comment period on the Draft TAR. The Alliance made multiple attempts after submitting its comments to EPA, to schedule meetings for the sole purpose of discussing comments, any concerns EPA might have with them, and to provide additional detail and data as might be needed by EPA to fully consider them. In all, the Alliance reached out to EPA at least four times in October and November 2016 to request such meetings. These offers included asking if EPA needed "additional supporting data for any of [the Alliance] comments" and noting that the Alliance wanted "to be sure that none of [the Alliance] comments [were] dismissed as not having enough support."[96] EPA assured the Alliance that it "[understood] the [Alliance] comments and [had] no questions at [that] time."[97]

Under these circumstances, EPA cannot reasonably contend that it may dismiss Alliance comments without a response because the Alliance did not submit sufficient supporting data. It is not enough for an agency to (i) solicit comment on its complex analyses and proposals, (ii) unreasonably and without justification cut the comment periods short such that stakeholders do not have time to prepare and submit data addressing those analyses and proposal; and (iii) then respond to the stakeholder's comments claiming that the comments lacked sufficient supporting data. Such a process is inadequate and such a response is arbitrary and capricious.

3. EPA Incorrectly Dismissed Analysis Conducted by Novation Analytics Which Supports Concerns Raised in Alliance Comments on the Draft TAR.

EPA rejects in its Proposed Determination research prepared by Novation Analytics under contract to the Alliance and submitted to the docket in support of the Alliance's comments on the Draft TAR.[98] EPA's assessment of Novation Analytics' methodology and findings is incorrect. We incorporate by reference the Alliance's response to similar criticisms provided to the House Subcommittee on Commerce, Manufacturing, and Trade and Subcommittee on Energy and Power, Committee on Energy and Commerce.[99]

Footnote continued from previous page
("While [the Alliance] did not provide sufficient information to determine with any certainty which parameters are the ones that should be compared…").

[96] Electronic Mail from Michael Hartrick, Director of Fuel Economy & Climate, Alliance of Automobile Manufacturers to Michael Olechiw Director – Light-Duty Vehicles and Small Engines Center, U.S. Environmental Protection Agency. (November 3, 2016).

[97] Electronic Mail from Michael Olechiw, Director – Light-Duty Vehicles and Small Engines Center, U.S. Environmental Protection Agency to Michael Hartrick, Director of Fuel Economy & Climate, Alliance of Automobile Manufacturers. (November 3, 2016).

[98] *See, e.g.,* EPA TSD Appendix A.

[99] Bainwol, Mitch, Questions for the Record Response, Midterm Review and Update on the Corporate Average Fuel Economy Program and Greenhouse Gas Emissions Standards for Motor Vehicles, Hearing, September 22, 2016. 10 et seq. Available at http://docs house.gov/meetings/IF/IF17/20160922/105350/HHRG-114-IF17-Wstate-BainwolM-20160922-SD006.pdf. (Accessed December 15, 2016).

EPA staff did not raise any questions or concerns with the Novation Analytics studies even when offered that opportunity. EPA turned down an in-person meeting to discuss the Novation Analytics Technology Effectiveness Phase 2 report ("Phase 2 Report") [100] and instead one EPA staff person participated in a briefing via web conference on May 17, 2016, with the Alliance, Global Automakers, Novation Analytics and California Air Resources Board staff and then did not ask any questions about the Phase 2 Report. This does not come close to fulfilling EPA's obligation to have a full airing and consideration of these issues.

The Novation Analytics reports referred to by EPA in Appendix A of the TSD were jointly commissioned by both the Alliance and Global Automakers, Inc., which together represent virtually all light-duty vehicle production in the United States. The Novation Analytics reports were reviewed by the Alliance and Global Automakers member companies with broad agreement that the results correlated well with their internal technology benefit and compliance modeling data. The Alliance has encouraged its members independently to submit their confidential business plans to EPA as supporting data for the general industry view that EPA has significantly underestimated the level of technology required for compliance in MY 2025.

The Alliance recommends that EPA engage more closely with auto manufacturers and Novation Analytics to understand the actual content and importance of the Novation Analytics studies.

4. The Proposed Determination Violates EPA's Obligation to Assess the Economic Impacts of Its Standards.

We can think of no case in recent history where EPA has applied so little actual economic analysis to the consideration of such important standards. EPA's proposed action would impose a regulatory burden estimated to reach $200 billion by 2025, without any numerical estimate of the economic impacts to the automobile industry.[101] In particular, this approach is troubling since EPA previously included a projection and analysis of the likelihood of mass unemployment and bankruptcy for a large U.S. automaker based on connection with the promulgation of much less stringent standards.[102] The MY 2022-2025 standards are much more stringent and costly; as a result, they are much more consequential to the industry. By rushing and issuing prematurely a Proposed Determination without any quantified sales or employment analysis, EPA is greatly underestimating the impact of an inaccurate Midterm Evaluation on the future of the automobile industry.

[100] Electronic Mail from Chris Nevers, Vice President, Energy and Environment, Alliance of Automobile Manufacturers to Michael Olechiw, Kevin Bolon, Ed Nam, Robin Moran, Daniel Barba, Joseph McDonald, and John Kargul, U.S. Environmental Protection Agency. (March 28, 2016).

[101] 75 Fed. Reg. 25,346 (May 7, 2010) (Table I.C.2-1); 77 Fed. Reg. 62,774 (Oct. 15, 2012). (Table III-6, Incremental Vehicle Program Cost.).

[102] 74 Fed. Reg. 49,485 (Sept. 28, 2009).

It is absolutely inadequate for EPA to state that since sales have not decreased to date with the imposition of more stringent fuel economy standards, that there will be no effect (discernible or otherwise) of future standards on sales and no need for numerical quantification of sales or employment.[103] It is also inadequate to state that, in the event there is a sales decline and employment reductions, autoworkers will be able to find other work in other states and thus no numerical quantification of employment effects is necessary in a full-employment economy. This reasoning does not equate to the sort of rigorous economic analysis upon which decisions of this magnitude should be based.

EPA's own regulations and executive orders require that sales and employment impacts be quantified.[104] Until EPA quantifies the impact to sales and employment, EPA should not and cannot finalize the Proposed Determination.

5. EPA Ignores Its Own 2012 Final Rule Which Requires an Employment Analysis.

The Alliance offered extensive comments on the Draft TAR regarding employment.[105] Those comments also noted EPA's obligation to conduct a quantitative employment analysis. Further, they highlighted the Alliance's concern that the MY 2022-2025 standards have the potential to cost 100,000 to 1,100,000 jobs in the U.S. economy due to loss of vehicle sales.

In the Proposed Determination, EPA acknowledges the Agency's obligation to study employment.[106] This obligation arises from language in the 2012 Rule listing "[i]mpacts on employment, including the auto sector" as one of the factors to be considered in the Midterm Evaluation,[107] and the regulations cite "the impact of the standards on the automobile industry" as one of the factors the Administrator must consider in making her determination on the appropriateness of the standards.[108] Further, the President has emphasized the importance of considering such factors.

> The Presidential Memorandum regarding fuel efficiency standards, explained that the President sought a program that would "strengthen the [auto] industry and enhance job creation in the United States."[109] Further

[103] EPA Proposed Determination at p. A-95: "The total effect of the standards on motor vehicle employment depends in addition on changes in vehicle sales, which are not quantified; thus, we do not estimate the total effects of the standards in the regulated industry."

[104] Alliance Draft TAR comments, Docket ID EPA-HQ-OAR-2015-0827-4089, Appendix F: Economic Assessment: Employment Impacts, at145 et seq.

[105] *See generally* Alliance Draft TAR Comments, Docket ID EPA-HQ-OAR-2015-0827-4089 at 145 et seq.

[106] EPA Proposed Determination at 3.

[107] 77 Fed. Reg. 62,784 (Oct. 15, 2012).

[108] 40 C.F.R. 86.1818-12(h).

[109] President Barack Obama, Presidential Memorandum Regarding Fuel Efficiency Standards, The White House, Office of the Press Secretary, May 21, 2010. http://www.whitehouse.gov/the-press-office/presidential-memorandum-regarding-fuel-efficiency-standards. (Accessed December 23, 2016).

> Executive Order 13563 states, "Our regulatory system must protect public health, welfare, safety, and our environment while promoting economic growth, innovation, competitiveness, and job creation."[110]

The fleet required to meet the MY 2025 standards under the Proposed Determination will result in higher retail prices,[111] and due to the elasticity of demand, it will reduce the number of vehicles sold.

A recent Center for Automotive Research ("CAR") study ("CAR Jobs Report") concluded that the MY 2022-2025 standards will potentially cause a loss of 100,000 to 1.1 million U.S jobs depending on total vehicle price increases (relative to current prices) related to the standards.[112] In response, EPA states without refuting those numbers, "[w]hile the 2022-2025 standards may have some effect on employment in the auto sector, this effect is likely to be small enough that it cannot be distinguished from macroeconomic and other factors affecting auto sector employment."[113] EPA also notes that "[t]he effects of the standards on employment are difficult to identify."[114]

Although EPA argues that a quantitative model is unnecessary, the Agency is nevertheless engaged in developing an economy-wide model to address employment impacts.[115] EPA has requested the Science Advisory Board (SAB) to review this modeling. We urge the EPA to maintain the original timing of the Midterm Evaluation, and use the time to refine and implement the model.

EPA suggests that future GHG standards won't impact sales (or therefore employment) because even with the current GHG standards the auto industry has recovered to pre-recession (and even record) sales and employment levels.[116] This conclusion is flawed. The industry's recovery resulted from a number of unusual factors, including the depth of the recession that created pent-up demand and the sharp fall in fuel prices. These factors are highly unlikely to recur in the near future. Further, the electrified powertrain technology believed by

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[110] President Barack Obama, Executive Order 13563 of January 18, 2011; *Improving Regulation and Regulatory Review, Federal Register* 76(14) (January 21, 2011): 3821-3823.

[111] EPA Proposed Determination at ES-4 (Table ES-1, per vehicle incremental cost increase of $800-$1,115). The Alliance believes that the incremental cost will likely be higher than those shown in the EPA analysis, but in any case, vehicle price increases are likely to occur with the addition of increasing levels of GHG control technologies.

[112] "McAlinden, Sean, et al, *The Potential Effects of the 2017-2025 EPA/NHTSA GHG/Fuel Economy Mandates on the U.S. Economy*, Center for Automotive Research, (Sept. 2016). Docket ID EPA-HQ-OAR-2015-0827-5803.

[113] EPA Proposed Determination at A-80.

[114] *Id.*

[115] EPA Draft TAR at7-6: "EPA is currently in the process of seeking input from an independent expert panel on modeling economy-wide impacts, including employment effects. For more information, see: http://yosemite.epa.gov/sab/sabproduct.nsf/0/07E67CF77B54734285257BB0004F87ED?OpenDocument."

[116] *Id.* at 26.

manufacturers to be required to meet future rules costs substantially more than the technology implemented to date.

The Alliance recommends that EPA not consider a Final Determination until a quantitative assessment of the MY 2022-2025 standard's impact on employment and where those impacts will occur can be made.

6. EPA Ignored Alliance Comments Regarding Employment Substitution Effects.

EPA's employment analysis explains that total employment is affected by the sum of employment changes due to the substitution effect and the output effect. In essence,

$$Employment_{total}\,\Delta = Employment_{Substition\ Effect}\,\Delta + Employment_{Output\ Effect}\,\Delta$$

Substitution Effect = The effect of regulation on labor intensity of production.
Output Effect = A decrease in production causes a decrease in labor demand.

EPA states: [117]

> In the Draft TAR (Chapter 7.4.2), we estimated this effect using the ratio of workers to each $1 million of expenditures in that sector. Though, as noted above, we received comments critical of our not quantifying the output effect, we did not receive comments on this approach to the substitution effect.

The Alliance did comment on EPA's substitution effect approach and recommended that EPA should reasonably conclude that significant declines in labor content are possible with the introduction of EVs and should adjust downward its substitution effects multiplier. [118] The Alliance also recommended that EPA should address factor shift effects due to reasonably anticipated declines in labor content of certain technologies, by, as an example, extrapolating and comparing the direct labor costs from the FEV teardown studies performed for fuel economy technologies considered in the 2012 FRM.

EPA's current approach does not correctly capture changes in "factor effects" where, due to historic secular trends that are occurring in the automotive industry (largely as a result of the extreme fuel economy increases required by the rules), the historic ratio of labor-to-parts-cost no longer is accurate. It is clear that some parts, particularly electrification technologies such as batteries and electric motors, will require significantly less labor than that EPA accounts for. The Alliance Draft TAR comments even included a chart (Figure F-1, page 149) as a reference highlighting the exceedingly small share of labor in the manufacture of an EV battery.

[117] EPA Proposed Determination at A-89:

[118] Alliance Draft TAR Comments, Docket ID EPA-HQ-OAR-2015-0827-4089 at 148.

In addition to the reduced labor content of the large consolidated parts used in EVs, the Alliance also pointed to changes occurring outside of the manufacturing process that would alter the historic share of labor, which the EPA should also take into account. [119] We noted one EV manufacturer's plans to create an assembly line that eliminates the use of human workers, and that same EV manufacturer's impacts on the way vehicles are sold and serviced.

As a result, EPA's statement that it expects that as a result of the increased costs of vehicles and parts, by itself, and holding labor intensity constant, employment would be expected to increase between 2021 and 2025 by a few hundred to perhaps 12,000 is likely in error. [120]

Therefore, the EPA should revisit its Proposed Determination and address these recommendations.

7. <u>EPA Fails to Make the Necessary Sales Estimates.</u>

The current state of low fuel prices, vastly different from the high prices that were predicted in the 2012 Rule, has resulted in a disconnect between customers' preferences and willingness to pay for fuel economy improvements. The projected vehicle fleet mix in 2025 has shifted from 67% passenger cars and 33% trucks to 52% cars and 48% trucks. [121] Customers consider a wide range of factors and vehicle attributes when making a purchase decision, including fuel economy. Strategic Vision New Vehicle Experience Survey data (NVES), a database of over 300,000 yearly customer responses about their newly purchased vehicle, shows that customers value fuel economy according to the current price of fuel, as shown in Figure 1. Although the priority that customers attach to fuel economy has varied, it has never, even in the period of high fuel prices, increased to greater than 6th place as a key consideration for purchase.

[119] Alliance Draft TAR Comments, Docket ID EPA-HQ-OAR-2015-0827-4089 at 150.

[120] EPA Proposed Determination at A-91.

[121] EPA Draft TAR at ES-8 (Table ES-1car/truck mix; 2012 Final Rule and AEO 2015 Reference).

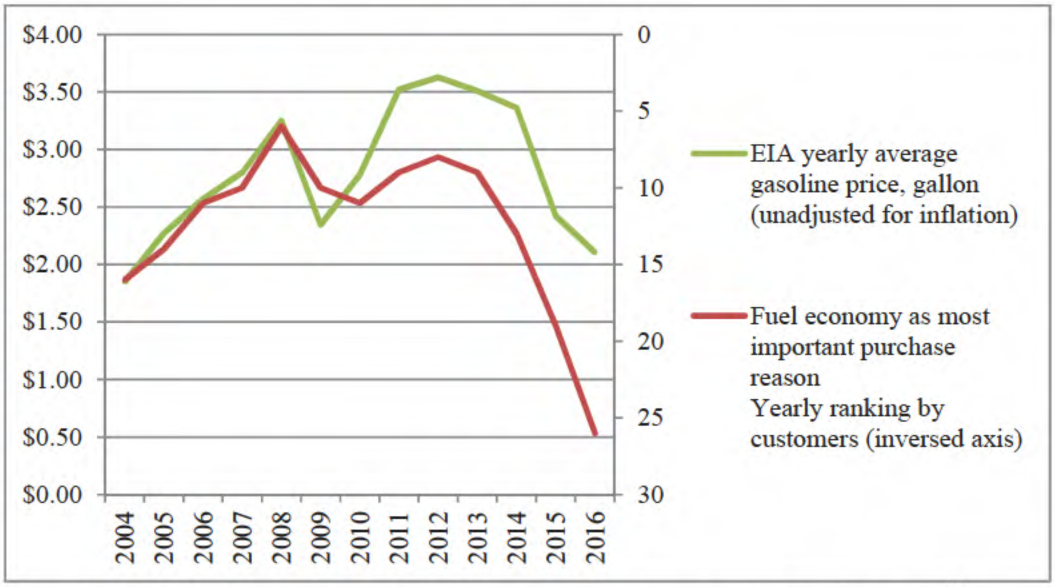

Figure 1: NVES Fuel economy as most important purchase reason versus gasoline price[122]

These data indicate that fuel economy in a low fuel price environment is not as high of a priority for customers. If customers do not consider fuel economy a top priority in their purchase decision process, it is also highly likely that customers are not performing any type of payback period calculations. Therefore, payback calculations of two to three years or even over the lifetime of a vehicle are not a priority in the customer's purchase decision process.

What customers are left to prioritize is the increased vehicle price as a result of the added fuel economy technologies necessary to meet the fuel economy standards. The Alliance has shown previously, and in these comments, that there are numerous flaws in the EPA modeling and additional and costlier technology will be needed than suggested by the Draft TAR and the Proposed Determination.[123] But even when using EPA's own cost estimates of technology (which also ignore the direct and opportunity cost impacts of electrification imposed by the California ZEV Mandate) EPA predicts that the cost of an average MY 2025 light-duty vehicle will rise by $875 as a result of the MY 2022-2025 standards.

EPA previously acknowledged a price elasticity for the demand of automobiles – that is, when price goes up, demand (sales) go down. In fact, as EPA and NHTSA reported at the time of the 2012 Rule, "[t]here is a broad consensus in the economic literature that the price elasticity of demand for automobiles is approximately –1.0, meaning that every one percent increase in the price of the vehicle would reduce sales by one percent…"[124]

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[122] Yearly average gasoline prices, not adjusted for inflation, obtained from EIA's December 2016 Monthly Energy Review, Table 9.4 Retail Motor Gasoline and On-Highway Diesel Fuel Prices, yearly average EIA gasoline prices for all areas https://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf (Accessed December 28, 2016).

[123] *See generally* Alliance Comments Draft TAR Comments, Docket ID EPA-HQ-OAR-2015-0827-4089.

[124] 77 Fed. Reg. 63,102 (October 15, 2012).

In the Proposed Determination, EPA disavows the applicability of this -1.0 elasticity of demand that it endorsed in 2012, calling it "old" and "…a short run elasticity estimate, which may not be appropriate for standards that apply several years into the future."[125] Accordingly, the Agency could have then used the long-term elasticity that was researched by CAR and provided to EPA in Table 14 of the CAR Jobs Report.[126]

Adopting a long-term elasticity value instead of a short-term elasticity value does not materially alter the fact that automobiles are a relatively inelastic good. As CAR notes in its Jobs Report:

> For most goods, the long-run elasticity is higher, as the ability to substitute other products increases over time. However, the only substitutes for a new vehicle is the purchase of a used vehicle or retaining a current vehicle (delaying purchasing), and the only source of used vehicles in the long run, is new vehicles. That both the short- and long-run elasticities are less than unitary defines motor vehicles as necessities (inelastic), reflective of the extreme importance of private vehicle ownership in the United States. In other words, an automotive consumer can choose to delay his/her purchase of a vehicle for only so long.[127]

CAR reports that the average long-run elasticity across its review of the literature is -0.72. EPA could use its preferred long-term elasticity, multiply it by the Agency's own vehicle price increase estimate and thereby arrive at a value for projected decreases sales in MY2025 relative to what would have occurred absent the MY 2022-2025 standards.

Notwithstanding such options, in the Draft TAR, EPA explains that, because the standards in place since MY2012 are national in scope, and because of their inability to control for other macroeconomic conditions, there is no way to identify a baseline for measuring the impact on sales.[128] Then, in the Proposed Determination, EPA cites "significant uncertainties involved in conducting a quantitative analysis"[129] as the reason for not quantifying an impact to vehicle sales.

The Alliance notes that EPA included estimates of sales decreases related to gasoline price increases in its analysis for the Draft TAR.[130] If EPA could do that for fuel prices, it should be able to do it for other factors as well. EPA states that the impact of the fuel economy

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[125] EPA Proposed Determination at A-40.

[126] McAlinden, Sean, et al., *The Potential Effects of the 2017-2025 EPA/NHTSA GHG/Fuel Economy Mandates on the U.S. Economy,* Center for Automotive Research (Sept. 2016).

[127] *Id.* at 27.

[128] EPA Draft TAR at 6-2.

[129] EPA Proposed Determination at A-40.

[130] *See* IHS-Polk Forecast and Report at Docket ID EPA-HQ-OAR-2015-0827-0403 and discussion thereof in Alliance Draft TAR Comments, Docket ID EPA-HQ-OAR-2015-0827-4089 at 116.

standards on sales will be secondary to other broader economy-wide effects.[131] It is not at all clear how the Agency can make such a statement if they have no way to judge the effect.

The Alliance requests that EPA not prepare a Final Determination without a quantitative analysis of the impact of the standards under consideration in the Midterm Evaluation on light-duty vehicle sales.

8. EPA Misconstrues the Alliance Comments on Consumer Surveys (NVES).

The Alliance comments on the Draft TAR recommended that EPA obtain access to a consumer survey database such as Strategic Vision's New Vehicle Experience Study for insights on consumer fuel economy valuation.[132] The Alliance comments and EPA's responses in the Proposed Determination are reproduced, in part, below to illustrate this point.[133]

Alliance Comments on Customer Priorities and Preferences:[134]

> A key component of the Midterm Evaluation should be an assessment of customer priorities and preferences when making a new vehicle purchase.
>
> Strategic Vision conducts a comprehensive post-purchase survey of over 300,000 new car buyers each year, investigating the motivations driving customer choices. The 2015 NAS Report acknowledges that Strategic Vision provides "the most reliable information about consumer preferences." ["Cost, Effectiveness and Deployment of Fuel Economy Technologies for Light-Duty Vehicles." National Academy of Sciences, National Research Council to the National Academies. 2015. 325.]

Alliance Recommendations:[135]

> In addition to the customer acceptance issues described above, which the Alliance recommends the Agencies consider during the remainder of the Midterm Evaluation process, the Alliance has some additional specific recommendations to improve the Agencies' treatment of customer acceptance issues, discussed below….
>
> *Research NVES data to get better understanding of customer choices/decisions*

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[131] EPA Proposed Determination at A-27. "EPA expects that any effects of the standards on the vehicle market will be small relative to market responses to broader macroeconomic conditions."

[132] Alliance Draft TAR Comments, Docket ID EPA-HQ-OAR-2015-0827-4089 at 143.

[133] EPA Proposed Determination at A-61.

[134] Alliance Draft TAR Comments, Docket ID EPA-HQ-OAR-2015-0827-4089 at 105.

[135] *Id.* at 143.

Strategic Vision's New Vehicle Experience Study (NVES) ["NVES." Strategic Vision. Accessed September 6, 2016….

The survey data can be mined and trended to infer, among other things:

- How new vehicle buyers rank fuel economy against other vehicle attributes
- What vehicle lines and segments customers choose when gasoline prices are high, or low
- What vehicle lines and/or segments customers buy given demographic and income characteristics
- Vehicle payment method, vehicle replaced, and future vehicle considerations

Access to similar data should give EPA insight into which types of customers are more likely to exit the pool of new vehicle buyers, or become unable to afford certain vehicle segments as new vehicle prices rise due to fuel economy requirements. Furthermore, this survey data would give EPA insight into customers' willingness to pay for fuel economy and/or willingness to compromise on vehicle choice. Finally, this data provides fresh evidence of how customers behaved during two critical periods in the automotive industry, including the 2008-2009 recession, which reflected a period of high gasoline prices, as well as the most recent 2014-2015 period of low gasoline prices. The latter period, with gasoline prices below $3/gallon, has added further downward pressure on smaller car segments and electric vehicle demand as customer favor larger segments and CUV/SUV mixes.

EPA's Response in Proposed Determination:[136]

Some market research firms conduct surveys of new vehicle buyers. These surveys, typically conducted a few months after purchase of a new vehicle, ask the buyer's views on a wide range of vehicle attributes. Several commenters encourage EPA to utilize such materials in its evaluation. Toyota, the Alliance of Automobile Manufacturers, and Fiat Chrysler specifically claim, incorrectly, that one company is endorsed by the NAS; instead, NAS commented that, "The most reliable information about consumer preferences comes from surveys of drivers who have made a recent new car purchase," and cite the one company as an example. [National Research Council (2015) …

[136] EPA Proposed Determination at A-61.

> The Alliance, Global Automakers, the National Automobile Dealers Association, and Fiat Chrysler cite findings from Strategic Vision…that fuel economy may not be the primary consideration in consumers' vehicle purchase decisions.
>
> While it is likely that lower fuel prices are a major factor in this result, it is possible that standards have also contributed to this finding: the vehicles with attributes that they seek are now more efficient. The National Academy of Sciences, in reviewing a number of surveys of the role of fuel economy in vehicle purchases, observes that "while consumers value fuel economy, they do so in the context of other attributes they also value." [National Research Council (2015) …EPA and the NAS find that the role of fuel economy in consumer purchase decisions is not well understood. Though these commenters appear to have access to at least one of these sets of survey results, they do not otherwise provide insights from these results on consumer response to vehicles subject to the standards.

EPA neglected to access a consumer survey database of over 300,000 yearly responses from customers who recently purchases new vehicles even though the Agency acknowledged the usefulness and the necessity for EPA to access such a database in the Draft TAR.[137] Instead, EPA references a survey by Consumers Union,[138] which surveyed a general population sample with over 10 percent not even owning a vehicle.

The Alliance recommends that EPA rely on customer surveys which use data generated from surveys of recent purchasers of automobiles as opposed to general population or vehicle intender surveys.

9. Effects of the Fuel Economy Standards on Low-Income Households.

The Alliance submitted comments to the Draft Tar which included a literature review of studies on the impacts of higher fuel economy standards on low-income household affordability of used cars.[139] This review found that fuel economy standards have a disproportionate impact on low income households.

The Alliance commissioned Defour Group LLC to prepare a response to issues raised by EPA in the Proposed Determination regarding the effects of fuel economy standards on low-income households. The response is included in these comments as Attachment 1.

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[137] EPA Draft TAR, Section 6.4.1.3, Chapter 6: Assessment of Consumer Acceptance of Technologies, at 6-12.

[138] EPA Proposed Determination at A-30

[139] T. Walton, Defour Group. "The Impact of Future Fuel Economy Standards on Low Income Households." September 2, 2016. Attachment 11 to Alliance Draft TAR comments.

10. Advanced Technology Vehicle Incentives Remain Important.

EPA discusses Advanced Technology Vehicle incentives in the Proposed Determination, noting its belief that no change is required, but requests further comment.[140] The Alliance provided comments on several aspects of the advanced technology vehicle incentives in its comments on the Draft TAR, and hereby reaffirms its position that changes should be considered as described therein.[141] EPA's response to the Alliance Comments in the Proposed Determination was "...the MY2022-2025 standards remain appropriate with the credit and incentive provisions currently in place and EPA is not proposing any changes to these provisions as part of the Proposed Determination."[142] Such incentives remain important in supporting the development of technologies that are still in a very early market stage.

We further note that, although helpful, the advanced technology vehicle incentives are not likely to be enough by themselves to create a significant market for such vehicles and to make up the difference between the technology levels estimated by EPA for compliance and those estimated by automotive manufacturers.

The Alliance recommends that EPA extend Advanced Technology Vehicle incentives through at least MY 2025.

11. EPA Fails to Model Technology Benefits Consistent with Its Own Regulations.

EPA promulgated test procedures for light-duty vehicles describing specific methods by which they must be tested.[143] Automakers are required to follow these test procedures when applying for a Certificate of Conformity with the Clean Air Act prior to introducing vehicles into commerce. Given the requirement to follow the specified procedures in physical testing, manufacturers do the same in computer simulations of future technology. In contrast, EPA simulations are not consistent with these regulations, potentially resulting in inaccurate assessments of the benefits of future technology. Where these concerns have been raised in comments on the Draft TAR, EPA's inadequate response is to dismiss them without analysis as unimportant or inconsequential.

EPA regulations at 40 CFR § 86.129-00 and 40 CFR § 1066.805 (depending on vehicle model year) require all light-duty vehicle testing to be conducted at equivalent test weight ("ETW") "bins" which are each comprised of a range of loaded vehicle weights.

Comments submitted on the Draft TAR by FCA US LLC noted that EPA's modeling did not follow EPA regulations which require testing be conducted at ETW.[144] EPA dismissed these concerns noting that "EPA's approach of allowing mass reduction in continuous increments

[140] *Id.* at 32, A-103 and A-108.

[141] Alliance Draft TAR Comments, Docket ID EPA-HQ-OAR-2015-0827-4089 at xiv and 174 et seq.

[142] EPA Proposed Determination at A-103.

[143] *See* 40 CFR Parts 86 and 1066.

[144] FCA US LLC Comments on Draft TAR, Docket ID EPA-HQ-OAR-2015-0827-4176 at 15.

(actually 0.5 percent increments in the OMEGA analysis) does not cause a systemic underestimation of costs, since cases where manufacturers may be getting less benefit from mass reduction than projected in our analysis would be offset by other cases where manufacturers may be getting more benefit." [145]

The Alliance disagrees with EPA's modeling approach which does not follow the Code of Federal Regulations. In the Proposed Determination, EPA alleges that a continuous function vs. the regulation's discrete bins will not cause a systemic underestimation of costs. EPA has failed to offer any evidence to support this claim. Even if such evidence were to be provided, the fact remains that the EPA OMEGA model is intended to demonstrate potential compliance pathways, but cannot since it fails to follow the regulations by which the vehicles modeled must be certified. As currently designed, EPA's modeling can show GHG improvements due to mass reduction that cannot occur when testing per the Code of Federal Regulations.

Similarly, engine technology modeling performed by EPA also does not follow regulatory requirements. As of MY 2020, EPA requires manufacturers to test vehicles for GHG emissions using a gasoline blended with ethanol.[146] However, instead of developing new baselines and technology modeling based on the new fuel for the Midterm Evaluation, EPA has chosen to continue modeling engine technology benefits using a test fuel only applicable to GHG certification through MY 2019.[147] EPA attempts to reason why this will not matter and to rebut auto manufacturer concerns provided in the Alliance's and others' comments to the Draft TAR. However, the fact remains that EPA has specifically chosen to continue modeling with fuel that does not match that required for testing in the timeframe covered by the Midterm Evaluation.

The Alliance recommends that EPA model future compliance in a manner consistent with its own regulations.

12. EPA Provides Inadequate Response to Alliance Recommendations for Model Output Plausibility Checks.

Given the broad range of concerns the Alliance has with the EPA technology benefit modeling, it requested that EPA apply three checks to its modeling outputs to determine whether the technology benefits modeled for specific vehicles exceeded plausible limits.[148] These checks were energy conversion efficiency, on-cycle-to-peak engine efficiency ratio, and city-to-highway cycle efficiency ratio with suggested specific numerical limits.

EPA acknowledged that "quality assurance processes are important for ensuring the validity of any modeling."[149] However, EPA declined to incorporate two of the suggested

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[145] EPA TSD at 2-413.

[146] See 40 CFR § 600.117

[147] EPA TSD at 2-210. (Referencing Tier 2 Indolene fuel.)

[148] Alliance Draft TAR Comments, Docket ID EPA-HQ-OAR-2015-0827-4089 at 41.

[149] EPA TSD at 2-282.

checks entirely.[150] EPA cited concerns with the limits chosen, but provided no analysis of the limits suggested or what limits it would find acceptable. Nor did EPA provide any reason for rejecting the methodology recommended. Where EPA did accept a recommended plausibility check (energy conversion efficiency), EPA did not explain its reasons for disagreeing with the suggested limit, and did not provide an alternative.

The Alliance again recommends that EPA implement all of the recommended plausibility checks.[151]

13. <u>EPA's Dismissal of the Alliance-Recommended Top Gear Gradeability Performance Metric is Based on Flawed Reasoning.</u>

EPA dismisses the Alliance recommendation for applying a "gradeability" metric for maintaining top gear at 75 mph while climbing a given grade.[152] EPA purports to support its position with three arguments, none of which are adequate. First, EPA speculates that downshifts with eight-speed transmissions are less noticeable to the driver.[153] However, no support for this contention is provided. Second, EPA notes that a single example vehicle downshifted significantly during a highway cycle test. The example vehicle chosen was a sedan generally marketed as a performance vehicle and is not necessarily representative of the entire U.S. fleet.[154] Nor is the gradeability performance metric based on a highway fuel economy cycle test which does not even reach 75 mph. Third, EPA cites three magazine articles as commenting that top gear is not maintained in another example vehicle.[155] This is a misrepresentation of the cited articles. The articles describe that the example vehicle generally did not make use of the top gear of the transmission. The cited articles appear to be a better example of how a manufacturer has taken a gradeability metric into consideration and has avoided the use of a gear which cannot be maintained without excessive shifting given the torque of the engine in the example vehicle. In short, EPA has simply dismissed a design consideration that many manufacturers use in the development of powertrain systems as unimportant. Manufacturers are best situated to understand their own customers, and EPA's disregard for such considerations artificially allows more engine downsizing (i.e. efficiency) than manufacturers will reasonably expect to achieve in future vehicles using advanced transmissions.

The Alliance again recommends that EPA apply a top gear gradeability performance metric in its technology benefit modeling to avoid technology packages that will not be commercially acceptable. We invite EPA to discuss the specific methods individual

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[150] *Id.* at 2-282.

[151] The Alliance recommends that EPA engage in discussions to consider plausibility checks with reasonable limits.

[152] EPA Proposed Determination at A-10. ("EPA does not believe this metric is appropriate for advanced eight-speed transmissions…")

[153] *Id.* at A-11.

[154] EPA TSD at 2-331.

[155] *Id.* at 2-331.

manufacturers use for this metric in order to inform its development of an appropriate measurement within its modeling.

14. EPA's Dismissal of Attachment 8 ("EPA ALPHA Samples Transmission Walk") is Premised in Part on a Misunderstanding of the Material Provided.

EPA states that the Ford simulation referenced by the Alliance assumed the same torque converter lockup strategy between transmissions whereas EPA's simulation did not.[156] This is incorrect. The referenced Ford presentation, included as Attachment 8 in the Alliance Draft TAR Comments clearly states that the torque converter lockup assumptions used by ALPHA were applied and that common torque converter lockup efficiencies was applied (not strategies). We further note that EPA has assumed 100% efficiency for a future torque converter without providing any supporting data.

EPA also implies that the Ford simulation referenced by the Alliance is not applicable because of differences between the Ford transmissions and the benchmark transmissions studied by EPA.[157] Both of the Ford eight-speed transmissions used in the Ford simulation contain similar design elements and have similar efficiencies to the EPA benchmark 845RE (ZF 8HP45) transmission.

The Alliance recommends that EPA reengage with manufacturers to better understand these technical concerns.

15. EPA Points to Past Performance as Indicative of Future Potential, but Neglects Key Considerations.

The most recent data available indicates that industry, on average, will not meet the MY 2016 requirements without using credits earned from past compliance margin.[158] The EPA should wait until the final MY 2016 GHG data is available (after March 31, 2017) and perhaps until early MY 2017 data is available before issuing any determination and reevaluate the efficacy of using the MY 2021 fleet as the reference fleet.

In EPA's assessment of the appropriateness of the MY 2022-2025 standards, EPA provides an evaluation of the existing fleet's progress toward meeting GHG standards.[159] The analysis describes the percentage of MY 2016 vehicles that meet the MY 2020 standards (approximately 21% assuming the theoretical generation of off-cycle credits) as a positive indication that the fleet is on track to meet MY 2025 targets. This analysis is misleading in that it does not closely examine the types of vehicles that are complying with the standards and are

[156] EPA Proposed Determination at A-10, Second paragraph, second bullet.

[157] *Id.* at A-10; Second paragraph, third bullet.

[158] *Novation Analytics MY 2016 Baseline Study*, December 20, 2016, prepared for the Alliance of Automobile Manufacturers and Association of Global Automakers.

[159] EPA Proposed Determination at 50.

subject to the Midterm Evaluation. It also fails to consider the shrinking compliance margins evident in recent compliance reports and updated projections. The analysis also focuses on MY 2020, a year not even under consideration in the Midterm Evaluation.

If EPA were to examine historical compliance data in the context of future compliance with the standards under consideration in the Midterm Evaluation, a completely different story emerges. Based on Appendix C of the TSD, only 5% of the MY 2016 vehicle models compliant with MY 2022 standards are non-hybrid, plug-in electric, or fuel cell vehicles. Not a single conventional vehicle, including vehicles with turbocharged-downsized engines, Atkinson cycle engines, advanced transmissions, stop/ start, variable valve timing, direct injection, and other non-hybrid technologies, currently meets the MY 2025 standards. Even when additional credits are assumed based on those estimated in the 2012 Rule, only hybrid, plug-in electric, and fuel cell vehicles meet the MY 2025 standards.

Compliance margins are also shrinking and the fleet is expected to already be at a deficit in MY 2016, just 5 years into a 14-year program. In MY 2014, manufacturers performed 13 g/mi better than their standards on average.[160] This compliance margin shrank to 7 g/mi in MY 2015.[161] At a manufacturer level, five manufacturers had either no compliance margin or actually generated debits in MY 2015.[162] According to a recent study by Novation Analytics examining MY 2016 fleet performance ("MY 2016 Baseline Study"), the expected MY 2016 fleet is projected to be at an 8 g/mi deficit.[163] This 8 g/mi deficit includes the use of credits. The early fleet compliance deficit suggests that using the 2021 model year as a reference for determining incremental costs toward 2025 model year compliance glosses over the fact that starting with the 2017 model year, the U.S. fleet will have a more challenging and costly path to 2025 model year compliance than assumed in the 2012 final rule. A full and thorough midterm review should closely reevaluate the efficacy of employing 2021 MY as the reference case fleet.

The full MY 2016 Baseline Study is provided as Attachment 2.

Important conclusions from the MY 2016 Baseline Study include:[164]

- Compared to the agency projections for the MYs 2012-2016 timeframe, the improvements in the passenger car and light-duty truck fleet 2-cycle tailpipe CO_2 performance have been at a rate that is lower than the agencies anticipated. This has increased manufacturers' reliance on credits for compliance with the footprint standards.

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[160] "Greenhouse Gas Emission Standards for Light Duty Vehicles – Manufacturer Performance Report for the 2015 Model Year." U.S. Environmental Protection Agency. EPA-420-R-16-014. November 2016. iii.

[161] *Id.*

[162] *Id.* at iv.

[163] *Novation Analytics MY 2016 Baseline Study*, December 20, 2016. 31.

[164] *Id.* at 50-51.

- The phase-out of FFV credits since MY 2015, particularly under the GHG program, has put pressure on fleet compliance with the standards. Additional A/C and Off-cycle credits and/or vehicle 2-cycle performance improvements must compensate for phased-out FFV credits.
- Even with the availability of credits, the light-duty truck fleet is projected to be at a deficit to the MY 2016 GHG footprint standards. With the loss of FFV CO_2 credit after MY 2015, net A/C and Off-Cycle credits generated by manufacturers in MY 2016 has not made up that deficit.
- The light-duty truck market share continues to increase at the expense of passenger cars, exposing more of its gap between actual performance versus agency projection. The resulting combined fleet performance has moved from compliance with the standards without credits, to requiring credits to comply, to underperforming relative to the standards even with current year credits generated.
- The gap between agency projections and actual performance is likely the result of over optimistic technology deployment assumptions on the part of the agencies. While manufacturers have exceeded agency expectations for certain technologies, such as spark ignition direct injection and high ratio-spread transmissions, other technologies have significantly lagged agency projections. Actual deployment of hybrids, for example, is much lower than projected.
- The over optimistic agency projected technology deployment rates can combine with agency assumptions on the technology's effectiveness as a key source of the agencies' over optimistic projected rate of 2-cycle tailpipe performance improvement. This is likely the case with agency's assumptions on hybrid technology.

The Alliance recommends that EPA cease pointing to past performance as indicative of future potential.

16. <u>Premature Release of the Proposed Determination Precluded Consideration of More Current Data.</u>

The premature release of the Proposed Determination precluded consideration by EPA of pending studies and more current information. EPA should return to the previously disclosed Midterm Evaluation schedule with a Proposed Determination sometime in mid-2017.

For example, the 2016 Baseline Study was one of the studies the Alliance intended to enter into the Administrative Record. Issuing the Proposed Determination early has led to a reliance on 2016 projections based on mid-model year data as explained in the EPA Trends Report, rather than on actual data which will be readily available on EPA's long-publicized timeline, and is inherently more reliable than projections.[165] In addition to using projections instead of actuals, EPA compounds the problem by cherry-picking projections from the Trends Report. For example, EPA relies on the projection of car market share increasing from 57.4% in MY 2015 to 62.1% in MY 2016. The MY 2016 Baseline Study predicts a car market share

[165] Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2016- Trends Report, U.S. Environmental Protection Agency, EPA-420-R-16-010, November 2016. 5.

decrease to 55.7% in MY 2016.[166] The difference between EPA and Novation MY 2016 car market share projections, 6.4 points, is not a minor error in the Proposed Determination analysis. A 6.4 percent market share represents over 1 million vehicles and must be fully analyzed based on the record.

In addition to the MY 2016 Baseline Study, the Alliance also has undertaken or sponsored other studies that could not be completed before the close of the Proposed Determination comment period. These include an assessment of the plausibility of Draft TAR modeling results[167] (expected January 2017) and the second stage of an Indiana University study on fuel economy policy (expected February 2017). The Alliance also believes that additional analysis of the revised ALPHA, lumped parameter, and OMEGA models is warranted. Studies related to consumer acceptance and impacts of the MY 2022-2025 standards on sales and the economy also are clearly needed.

The Alliance recommends that EPA return to originally anticipated timelines for the Midterm Evaluation to allow for the consideration of additional data under preparation by stakeholders.

17. The Alliance Has Additional Concerns Regarding the OMEGA Optimization Model Used by EPA to Derive Costs and Benefits Associated with the MY 2022-2025 Standards.

The Alliance is concerned with the OMEGA model design and its resulting "optimized" output. OMEGA generally seems to deliver a level of fleet optimization that manufacturers cannot replicate. For example, the approximately 2,600 vehicles in the MY 2015 baseline fleet become approximately 7,200 in the MY 2025 fleet. This near tripling of combinations of technology is not realistic from a technology investment or vehicle sales perspective. In practice, manufacturers would not be expected to actually build a compliant fleet as modeled. Such departures from the more ideal perspective presented by EPA would naturally be expected to add additional costs which EPA fails to account for.

The OMEGA model also yields conflicting technology packages for some vehicles. For example, MY 2025 control fleet vehicle index 633 has two technology packages that are nearly identical except for in that one technology package uses a 12-volt stop start system and the other uses a higher voltage mild hybrid system. It is difficult to believe that a manufacturer would invest in both types of systems for a single vehicle in a single model year. Selling such a system could also be problematic. A customer would be asked to choose between what are identical vehicles that operate in what will be perceived to be almost identical fashion, but in the case of the mild hybrid system to pay ~$450 additional for what will amount to less than $100 of fuel savings per year. It is more likely that if the 12-volt engine stop-start system is not sufficient for

[166] *Novation Analytics MY 2016 Baseline Study* at 13.

[167] The Alliance notes that the accelerated timing of the Proposed Determination further limits the applicability of a study of Draft TAR modeling results and therefore has also expanded the study to assess a limited number of results from the Proposed Determination.

compliance, that the manufacturer will invest in the higher benefit mild hybrid system. Although this would theoretically allow less technology to be placed on a different vehicle, technology costs and benefits vary between vehicles and would not necessarily balance.

The Alliance recommends that EPA constrain its optimization modeling such that a given vehicle in the baseline fleet corresponds to a single vehicle in the MY 2025 reference and control fleets to avoid an optimized solution which is not practical to implement.

18. EPA States That It Has Executed Technology Benefit Modeling On a Performance Neutral Basis, but the Supporting Electronic Files Suggest Otherwise

EPA considers performance neutrality as important in modeling the benefits of future technologies so that they are compared on a consistent basis.[168] To meet this goal, EPA states that "ALPHA modeling runs generate effectiveness values which maintain a set of acceleration metrics within a reasonable window."[169] Within the ALPHA files generated in support of the Proposed Determination, there is a file for each "ALPHA Class" of vehicles (e.g. "LPW_LRL" and "Truck") named as [ALPHA Class]_LPM_matrix_selected_results_[date code].[170,171] Each of these files contains vehicle emissions and performance information including acceleration times. The ALPHA "Truck" class file shows 0-60 mph acceleration times averaging 15.9 seconds. In comparison, the most recent EPA Trends report indicates that pickup truck 0-60 mph acceleration times average around 8.5-9 seconds in MY2015 and have not been in the 15.9 second range since the early 1980's.[172] Modeling of what appears to be technologies that provide acceleration rates at little over half of what is observed in the baseline fleet is inconsistent with the premise of performance neutrality.

The Alliance recommends that, at minimum, EPA examine 0-60 mph acceleration times of exemplar vehicles for the 29 ALPHA vehicle types and verify that ALPHA model results used in the calibration of the lumped parameter model maintain performance consistency with the baseline vehicles.[173]

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168 EPA TSD at 2-207.

169 *Id.* at 2-208.

170 See Advanced Light-Duty Powertrain and Hybrid Analysis ALPHA Tool, U.S. Environmental Protection Agency. . Accessed December 21, 2016. (Under the "ALPHA V2.1 Calibration Samples" heading, click the link to "ALPHA v2.1 Calibration Samples (ZIP)", open the 20161128_ALPHA folder, open the subfolder for each of the ALPHA classes.)

171 Based on the file name convention, the Alliance assumes that these files contain the ALPHA model outputs used in calibrating the EPA lumped parameter model for use in technology benefit modeling.

172 Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2016, U.S. Environmental Protection Agency, EPA-420-R-16-010, November 2016. 36.

173 This recommendation is made only in the context of EPA's stated intent to maintain performance neutrality. The Alliance reaffirms its previous comments on the Draft TAR describing concerns related to the availability of downsized engines, limits on engine displacement to vehicle mass ratio and top gear gradeability performance. (Alliance Draft TAR Comments at 33 et seq.)

19. The Alliance and Other Stakeholders Were Not Given the Opportunity to Adequately Review and Assess the ALPHA Model.

The ALPHA model, used to inform the Draft TAR and Proposed Determination, was peer reviewed with a report on the peer review findings published in October 2016.[174] Peer reviewers selected included representatives from National Laboratories, academia, and environmental advocates. Auto manufacturers and other stakeholders were not provided any significant opportunity to examine the model in detail before or during the abbreviated Draft TAR and Proposed Determination comment periods. Furthermore, when an Alliance contractor attempted to open the Matlab files provided by EPA in association with the Proposed Determination, license and encryption issues prevented preliminary examination. While we are sure that these issues can be resolved between EPA and the contractor, the fact remains that the 30-day comment period provided for the Proposed Determination was not sufficient to resolve these types of issues.

The Alliance recommends that EPA ALPHA modeling teams engage in discussions with stakeholders to better understand their concerns with the current ALPHA model.

20. EPA Incorrectly Attributes Alliance Concerns with the Technology to Meet the MY 2022-2025 Standards to an Alliance Belief That Only Existing Technologies Can Be Used For Compliance.

As described in its comments on the Draft TAR and herein, the Alliance and its members believe that the MY 2022-2025 standards cannot be met with the technology deployment rates modeled by EPA. EPA interpreted Alliance comments such as these as relying on studies prepared by Novation Analytics (which EPA did not agree with) and to manufacturer beliefs that only technologies available in the MY 2014 baseline fleet (and without subsequent improvements to those same technologies) would be available for compliance in MY 2025.[175] The EPA's interpretation of the Alliance comments is incorrect. Although the referenced Novation Analytics studies certainly support that a stronger mix of technology is likely to be required and that EPA modeling in the 2012 final rulemaking was suspect, our comments are not founded on the premises ascribed to the Alliance by EPA. Rather, the Alliance comments are based on the internal and fact-based analyses of its members. The Alliance expects that several of its members will be submitting their own confidential comments in response to the Proposed Determination to demonstrate this to EPA.

The Alliance recommends that EPA reengage with key stakeholders such as auto manufacturers to understand their concerns.

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[174] Peer Review of ALPHA Full Vehicle Simulation Model, Assessment and Standards Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, EPA-420-R-16-013, October 2016.

[175] EPA Proposed Determination at 22.

21. EPA Fails to Provide Adequate Documentation of the Verification and Methodology for Calibrating the Lumped Parameter Model.

EPA relies upon its lumped parameter model ("LPM") to inform its optimization model of the GHG and fuel economy benefits of various future technology packages.[176] The specific processes by which EPA calibrates the LPM from benchmarking and simulation data is critical, particularly in light of the multiple changes in the tool from its first use in establishing MY 2012-2016 standards, to the Draft TAR, and now with additional changes for the Proposed Determination. EPA has not provided substantive documentation of how the LPM was calibrated from other models. Nor has EPA provided any documentation verifying the model's ability to accurately predict technology benefits other than in comparison to other EPA models.[177] Additionally, although the Proposed Determination and TSD discuss the lumped parameter model, the version used for the Proposed Determination was not directly provided on EPA's Lumped Parameter Model website.[178] Instead the model is a spreadsheet tab within a much broader spreadsheet without any clear directions in its use.

This lack of documentation and verification has prevented the Alliance from adequately assessing the accuracy and precision of the lumped parameter model's capabilities, particularly in the limited time provided for comment to the Draft TAR and Proposed Determination. The Alliance recommends that EPA fully document the spreadsheet version of the LPM or any other version of the LPM that is used to inform the OMEGA model. Such documentation would ideally include specific instructions for the model's operation, descriptions of the development and theory behind the model, method of calibration from the ALPHA model and other data sources, and verifications against both full vehicle simulation models and actual vehicles.

Given the LPM's critical role in informing the EPA's Proposed Determination, the Alliance further recommends that EPA provide such documentation and subsequent time for review and discussion with stakeholders prior to proceeding further with the Midterm Evaluation.

22. EPA's Response to Alliance Comments Regarding Atkinson Cycle Engine Technology Benefits is Inadequate.[179]

The Alliance provided significant comments to the Draft TAR detailing concerns of feasibility and effectiveness of the non-hybrid Atkinson engine technology packages including

[176] EPA TSD at 2-274.

[177] One potential validation would be to model the predicted technology benefits from technology added between a historical model year (e.g. MY 2008) and the present MY 2015 baseline and to compare predicted GHG emissions to those actually achieved by the MY 2015 vehicles.

[178] The LPM used to inform the Proposed Determination is located within the OMEGA model "Machine" files. The Alliance acknowledges that when this issue was brought to the attention of EPA staff, the staff provided a timely response and directed the Alliance to the appropriate file. The Alliance appreciates the responsiveness of the EPA staff in this instance.

[179] EPA Proposed Determination at 48; TSD at 2-308 et seq.

cooled EGR and cylinder deactivation.[180] EPA's response to these comments oversimplifies the requirements of introducing complex engine architectures to a large portion of the new vehicle fleet. EPA continues to overestimate the effectiveness of this technology and the ability of manufacturers to implement it in the time period covered by the Midterm Evaluation.

EPA has not sufficiently responded to comments regarding implementing 4-2-1 exhaust manifold in existing vehicle architectures.[181] EPA describes that a prior implementation of SkyActiv technology used a more conventional exhaust manifold.[182] Mazda itself describes the 4-2-1 exhaust manifold as a key enabler to realize the benefits of its second generation Atkinson cycle engine technology.[183] EPA also states that it does not believe that coordination with vehicle redesign is necessary.[184] However, Mazda describes the packaging of the 4-2-1 exhaust manifold as "[requiring] coordination with 'Skyactiv-Body'" activities.[185]

The Alliance also presented concerns with EPA's ability to demonstrate its modeled benefits of Atkinson, cooled EGR, and cylinder deactivation technologies.[186] The EPA response focuses on the availability the various technologies in example vehicles.[187] However, the EPA response is irrelevant because it ignores the primary concern of the Alliance comments – that there is no current example of combined Atkinson, plus cooled EGR, plus cylinder deactivation technology in the present fleet to verify EPA's modeled benefits and that EPA could not provide physical test results replicating its modeled benefits of these combined technologies.

The Alliance again recommends that EPA take caution when relying on unverified technology benefits to support conclusions regarding the practicability and feasibility of future standards and to engage in discussions with auto manufacturers regarding their methods for modeling future vehicles.

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[180] Alliance Draft TAR Comments, Docket ID EPA-HQ-OAR-2015-0827-4089 at 45 et seq.

[181] EPA TSD at 2-310.

[182] *Id.* at 2-310.

[183] Mazda. *What's All This Skyactiv nonsense anyway?* Dave Coleman, Presentation at Center for Automotive Research Management Briefing Seminars, August 2012.
http://www.cargroup.org/assets/speakers/presentations/36/coleman_dave.pdf. (Accessed December 21, 2016.) 16.

[184] EPA TSD at 2-310.

[185] [185] Mazda, "*What's All This Skyactiv nonsense anyway?* Dave Coleman, Presentation at Center for Automotive Research Management Briefing Seminars, August 2012;
http://www.cargroup.org/assets/speakers/presentations/36/coleman_dave.pdf. (Accessed December 21, 2016.) 16.

[186] Alliance Draft TAR Comments, Docket ID EPA-HQ-OAR-2015-0827-4089 at 45.

[187] EPA TSD at 2-309.

23. EPA Gasoline Turbocharged Direct Injected ("GTDI") Engine Maps Remain Optimistic in Comparison to Estimates of Similar Technologies by NHTSA and to Benchmark Data.

EPA assessments of engine technology benefits appear highly optimistic to manufacturers, even after considering further development and combinations of known technologies. To illustrate this point, the Alliance compared the EPA's 1.17 L GTDI engine with cooled EGR fuel map to the corresponding fuel map used by NHTSA in the Draft TAR for a 1.2L GTDI with cooled EGR. All fuel maps were scaled to a common displacement using the same process utilized for the EPA ALPHA model. Additionally, the NHTSA GTDI fuel map results were normalized for test fuel differences.[188] Figure 2 compares the normalized NHTSA fuel map to the EPA fuel map. The differences between the EPA and NHTSA maps are shown as percent difference. Positive values indicate regions where EPA estimates lower fuel flow (i.e. indicating higher efficiency) than NHTSA; negative values are regions where EPA estimates higher fuel flow. Overall, EPA projects 10-20% lower fuel flow than NHTSA in operating regions applicable to GHG and fuel economy compliance for the same set of technologies when compared on a normalized basis.

[188] The NHTSA GTDI fuel map utilized MY 2025 Tier 3 fuel properties (i.e. E10, regular grade octane) whereas the EPA fuel map relies on the use of outdated Tier 2 (E0, premium grade octane) fuel.

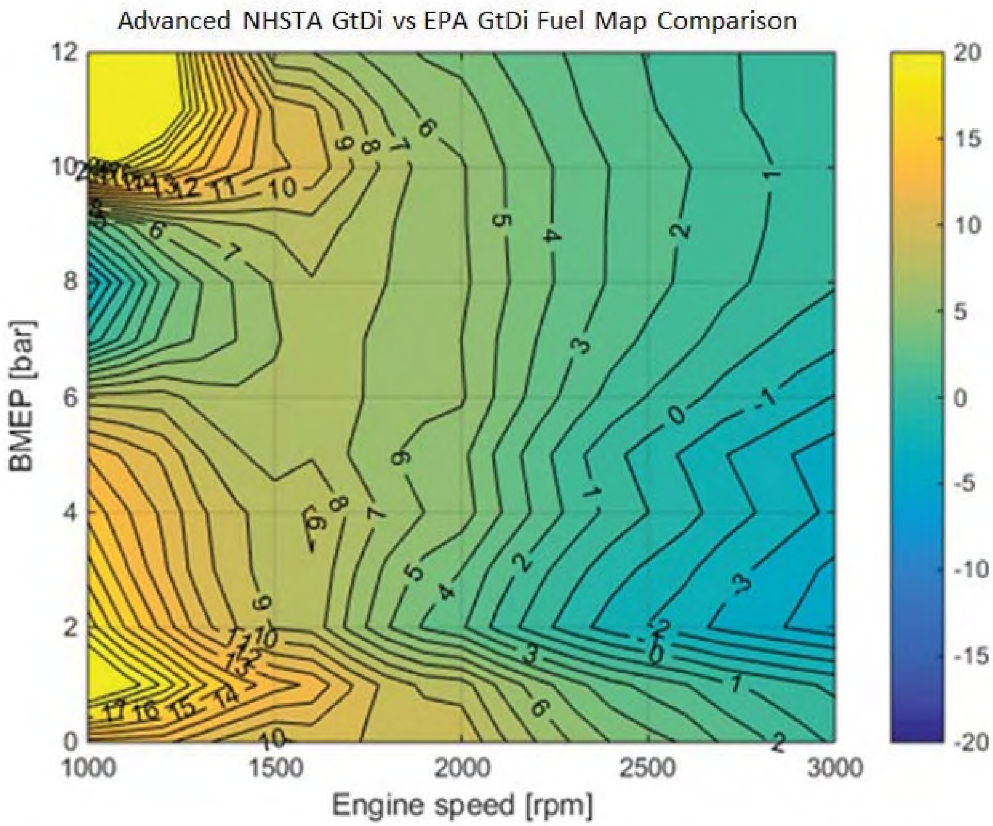

Figure 2: Comparison of EPA 1.17L GTDI plus cooled EGR engine fuel map to NHTSA 1.2L GTDI plus cooled EGR engine fuel map. Differences are shown as percentages. Positive values indicate lower fuel flow in EPA map.

The Alliance performed a similar analysis comparing the EPA 1.17L GTDI plus cooled EGR engine fuel map to the EPA benchmark 2.7L GTDI engine as shown in Figure 3. Fuel flow for the 2.7L engine was normalized for displacement using the same process applied by EPA in the ALPHA model. Again, the engine map used by EPA for ALPHA modeling shows 10-20% lower fuel consumption in the city / highway test cycle operation area. Even assuming that some portion of the difference can be attributed to the inclusion of cooled EGR on the 1.17L engine, the incremental difference challenges credibility.

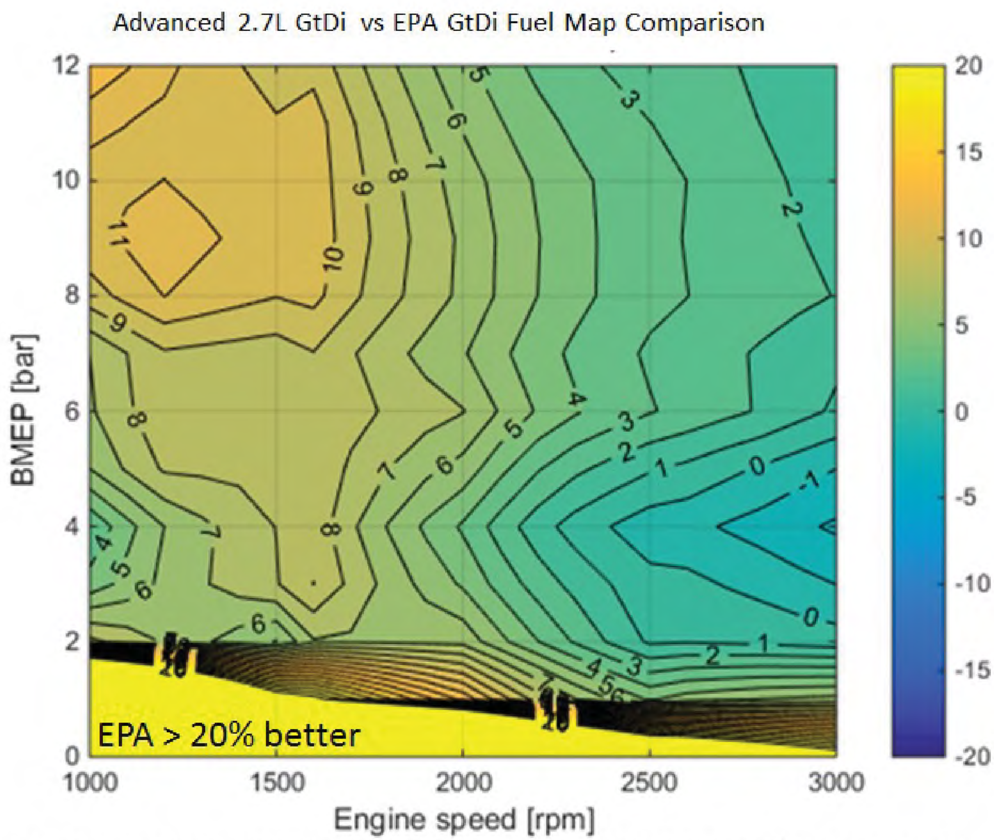

Figure 3: Comparison of EPA 1.17L GTDI plus cooled EGR engine fuel map to normalized EPA 2.7L benchmark GTDI engine fuel map. Differences are shown as percentages. Positive values indicate lower fuel flow in EPA map.

The Alliance additionally points out the both the future NHTSA and EPA engine fuel maps grossly underestimate engine fuel flow at light loads. When comparing the EPA theoretical future engine fuel map to the EPA benchmark engine (Figure 2), the future engine fuel flow at 1 – 2 bar BMEP is much greater than 20% better (i.e. lower fuel flow). The Alliance believes that this is due, at least in part, to model fitting error.

The differences described in Figures 2 and 3 make a significant difference to the ultimate technology benefits modeled in ALPHA. A vehicle with the properties described in Table 1 was simulated in ALPHA using the EPA 1.17L GTDI plus cooled EGR, the NHTSA (normalized) 1.2L GTDI plus cooled EGR, and EPA (normalized) benchmark 2.7L engine without cooled EGR fuel maps. Results of these simulations are shown in Table 2. The EPA 1.17 GTDI plus cooled EGR fuel map yields results 9% better than even the NHTSA map with nominally the same technologies. Similarly, the EPA map used in ALPHA simulations for the Proposed Determination yielded 11% better results than the benchmark engine.

Table 1: Vehicle properties for ALPHA model simulation example

ETW	3,750 lb
CdA	1.2 m^2
RRC x 1,000	7.2
Tire rev / mi	700
Transmission	EPA 8-speed automatic (see ALPHA model)
Final Drive Ratio	3.55

Table 2: Comparison of ALPHA results using vehicle properties from Table [x] and different fuel maps

Engine Map	Combined Unadjusted CO_2 (g/mi)
EPA 1.17L GTDI plus cooled EGR	180
NHTSA (normalized) 1.2L GTDI plus cooled EGR	198
EPA (normalized) 2.7L GTDI without cooled EGR	203

The Alliance comments regarding these comparisons are necessarily brief given the short period of time permitted for comment. We invite EPA to engage in a more thorough technical discussion of the methodologies applied in this analysis and industry concerns with the EPA 1.17L GTDI plus cooled EGR fuel map.

24. There is a Great Need for Further Technical Discussion.

Given the complex and technical nature of modeling future technologies, we recommend that EPA meet with technical experts from automotive manufacturers to have detailed discussions with the purpose of addressing fundamental disagreements in modeling of technology benefits. Such discussions do not lend themselves well to carefully coordinated workshop presentations and public-facing documents. Expert engineers from both EPA and the automotive manufacturers will be best suited to describing, in person, their varying viewpoints to gain an understanding of the concerns of both parties. There is no reason why engineers should not be able to come to substantially similar conclusions on the potential benefits of future technology development which will likely occur over the next five to eight model years.

25. Further Technical Changes Are Necessary in the Proposed Determination.

Modeling of future technologies and costs is a highly technical undertaking. In the Proposed Determination and TSD, EPA describes its response to many of the comments it received on the Draft TAR. In some cases, the analysis remains the same as described in the Draft TAR; in others EPA has chosen to modify its analysis. The resulting new analysis is described in the TSD, which encompasses over 700 pages plus supporting electronic files.

EPA provides an extensive list of what it considers key changes and updates in its analysis for the Proposed Determination.[189] Considering the complexity of some of these changes and the time allotted for review, the Alliance cannot provide adequate comment on these

[189] EPA TSD at 2-3.

modifications at this time and reserves its rights to supplement the Administrative Record as new information becomes available.

26. EPA's Response to Technology Lead-Time and Adoption Is Inadequate and Misleading.

In the TSD, EPA describes several "universal" comments to the Draft TAR.[190] Included among these are comments from auto manufacturers and their trade associations on lead-time required for technology development and adoption (i.e. phase-in across product lines). EPA states a belief that lead-time is adequate because the technologies considered are either currently in production, or will be commercially produced in the next several years.[191] EPA further asserts that lead-time is effectively measured from when the MY 2022-2025 standards were first promulgated (i.e. 2012).

Contrary to EPA's statements, many key technologies considered by EPA are not currently in production, e.g. non-hybrid Atkinson engines with higher compression ratios in combination with cooled EGR and cylinder deactivation, designed to run on regular grade U.S. market fuels. EPA's statement that some of these technologies will be commercially produced in the "next several years" is so vague as to be meaningless.

Furthermore, attributing technology development and adoption across the entire U.S. automotive industry based on single examples does not reflect the wide diversity of manufacturers, their product lines, their customers, and their resources to make such changes.

The Midterm Evaluation was conceived in order to mitigate the errors and uncertainty associated with setting standards so far into the future. As such, implications that lead-time can be measured from that original rulemaking are not accurate.

The Alliance recommends that EPA reconsider lead-time in the context of design and development of technologies on a manufacturer-by-manufacturer basis.

27. EPA Failed to Respond Adequately to Alliance Comments Regarding Concerns with Applying Atkinson Technology at the Projected Rates Across the U.S. Fleet.

In response to the Alliance comments regarding Atkinson technology penetration rates EPA describes Mazda's phase-in of its Skyactiv technology including Atkinson cycle engines.[192,193] The Alliance believes that this response is inadequate. The concerns presented by the Alliance are primarily related to auto manufacturers who have not already invested significantly in such technology, but who have instead invested in other alternatives. The

[190] *Id.* at 2-207.

[191] *Id.*

[192] Alliance Draft TAR Comments, Docket ID EPA-HQ-OAR-2015-0827-4089 at 50.

[193] EPA Proposed Determination at 48, n. 62.

example cited by EPA is for an auto manufacturer who has invested in this technology as a primary pathway to compliance since 2012, and which has a relatively small number of product offerings. This cannot necessarily be replicated by all auto manufacturers. The choice of this example suggests that EPA was unable or unwilling to refute the Alliance's broader concerns directly.

The Alliance recommends that EPA seek to better understand lead-time requirements associated with the design and development of new technology for individual manufacturers, investment constraints, and general practices for implementing technology across multiple vehicles.

28. EPA's Response to Stakeholder Comments Regarding the Use of Incorrect Test Fuels is Incomplete.

In response to Alliance and other stakeholders' comments expressing concern with EPA's use of higher octane, zero ethanol fuels in developing modeled technology benefits, EPA discusses how current engines are not typically knock limited in city and highway test cycle operation.[194] This response is incomplete. While EPA's statements that engines are not knock limited in city and highway testing for GHG certification may be true for some of today's engines, technical experts at automotive manufacturers believe that the future downsized engines described by EPA may very well be.

The Alliance recommends that EPA consider the impact of lower octane test fuels in the context of future downsized engines.

29. EPA did Not Address Safety Concerns and Did Not Coordinate with NHTSA on the Updated Safety Analysis.

The Alliance raised two major concerns over EPA's draft TAR safety analysis in the Alliance's Draft TAR comments. The first issue was the EPA's use of two highly correlated factors (mass and foot print) in a regression analysis. This can lead to non-physical results. Examples include possible fatality increases involving collisions with fixed objects and heavy vehicles. The second concern is the apparent disconnect between the EPA Draft TAR safety analysis and the NHTSA 2016 VOLPE Report.[195] Neither issue was addressed in the Proposed Determination.

The Alliance recommends the EPA coordinate with NHTSA on safety analyses and address the concerns as highlighted in the Alliance Draft TAR comments before making a Final Determination.

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[194] EPA TSD at 2-211.

[195] 2016 Volpe Report (Table 3-7) and Table 8.7 of the Draft TAR.

30. EPA dismissed or ignored numerous other Alliance comments on the Draft TAR but the shortened comment period prevents us from providing further details at this time.

The chart below provides examples of comments made by the Alliance on the Draft TAR which were either dismissed or ignored by EPA in the Proposed Determination. For purposes of this chart only, Alliance Comments on the Draft TAR are abbreviated as **TAR Response** and EPA's Response to Comments in Proposed Determination is abbreviated as **PD**.

No.	**Alliance Comments**	**EPA Response**	**Result**
1.	EPA should make a quantitative estimate of sales impacts (TAR Response at xv, 115-116)	EPA has chosen for this Proposed Determination to continue with the qualitative approach that it used for setting the standards in the 2012 FRM, and in the Draft TAR, due to the significant uncertainties involved in conducting a quantitative analysis (PD at A-40)	Dismissed
2.	The Agencies should provide, in detail, the assumptions relied upon in estimating sales in 2025. (TAR Response at 116)	none	Ignored
3.	Employment substitution effects: The Alliance Draft TAR comments (page 148) did comment on EPA's substitution effect approach and recommended that EPA should reasonably conclude that significant declines in labor content are possible with the introduction of EVs and should adjust downward its substitution effects multiplier. The Alliance also recommended that EPA should address factor shift effects due to reasonably anticipated declines in labor content of certain technologies, by, as an example, extrapolating and comparing the direct labor costs from the FEV teardown studies performed for fuel economy technologies considered in the 2012 FRM. (TAR Response at 148)	Though we received comments critical of our not quantifying the output effect, we did not receive comments on this approach to the substitution effect. EPA states it expects, as a result of the increased costs of vehicles and parts and holding labor intensity constant, that employment would be expected to increase between 2021 and 2025 by a few hundred to perhaps 12,000. (PD at A-89).	Dismissed
4.	For the Midterm Evaluation, the Agencies (as well as Congress, state	None. Additionally, nowhere does EPA discuss vehicle affordability in	Ignored

	officials, and the general public) must evaluate how the slowdown in growth of disposable personal income, combined with the Federal Reserve's recent decision to begin increasing interest rates (thereby increasing the cost of capital), will impact customers' ability to afford the increasingly expensive technologies needed to meet the future CAFE and GHG standards. This analysis must take into account that other regulations will simultaneously have an impact on vehicle production costs and achievable fuel economy. (TAR Response at 119)	the overall context of price increases associated with its regulations between the MY 2015 baseline and MY 2025 endpoint.	
5.	Requested quality control checking parameters in the ALPHA output files. (TAR Response at 42)	EPA describes the inclusion of 150 columns of data and quality control parameters in ALPHA output files. (TSD at 2-271). However EPA fails to note whether ALPHA calculates the requested parameters and instead suggests that stakeholders modify ALPHA themselves. To even run the existing ALPHA model requires the purchase of a licensed software product (over $2,000).[196] Given the lack of time provided within the comment period to take such action, stakeholders have been deprived of a substantive response to this issue.	Dismissed
6.	Use of magazine articles to show consumer acceptance (TAR Response at 111). • Not clear if reviewers appropriately represent average customers' view of fuel efficiency technologies	EPA asserts that counting reviews in automobile enthusiast magazines is a proxy for determining customer acceptance of these technologies. (PD at 6)	Ignored

[196] Mathworks. Matlab Pricing and Licensing; Standard Individual License. https://www.mathworks.com/pricing-licensing.html?prodcode=ML&intendeduse=comm. (Accessed December 27, 2016.)

	• Unclear if strong conclusions can be made with only 30% of technologies studied having over 100 evaluations • Issues with simple majority methodology to determine if views were positive or negative (anything with more views positive must be acceptable) – manufacturers would find 40% negative reviews to be a serious issue.		
7.	California's ZEV costs are ignored by EPA in the Draft TAR. (TAR Response at xi, 180)	EPA dismisses the issues raised without thorough analysis. PD at A-109). Comment is acknowledged in TSD at 1-32).	Dismissed
8.	Green Car Loans: The Alliance discusses positions on green auto loans and how they are unlikely to significantly impact consumers' access to credit as an offset to higher prices (and subsequent loan amounts.) (TAR Response at 112)	EPA agrees that these loans do not "explicitly factor fuel savings into the calculation." However, EPA maintains that these programs provide a means to mitigate the effects of higher up-front costs to buyers. (PD at A-74). The EPA response fails to consider that a ¼ point adjustment in an interest rate, will not save buyers money up front. Additionally, these incentives do not apply equally across consumers as they are dependent on a consumer's credit score. It is inappropriate to state this benefit can be taken advantage of by all new car purchasers.	Dismissed
9.	Off-Cycle Credit Cap: The cap on the allowed number of off-cycle credits should be removed. (TAR Response at 69)	EPA asserts that the original reasoning for applying a cap has not changed. (PD at A-105)	Dismissed
10.	48V Mild Hybrid Credits: Mild hybrids have greater benefits than stop-start systems and should receive greater credit.	EPA asserts that no change is warranted. (PD at A-105)	Dismissed

11.	Off Cycle Credits: Expand the menu by comparing to EU technologies (TAR Response at 162 & 168)	EPA discusses issue. (PD at A-105-106)	Dismissed
12.	Criteria and Particulate Matter Emissions Compliance Effects on GHG: Manufacturers expect GHG emissions impacts associated with criteria and particulate matter emissions to have an effect on GHG compliance. (TAR Response at 30)	EPA discusses options for reducing criteria and particulate matter emission that do not degrade GHG, but nowhere analyze the costs or other implementation issues associated with them. (TSD at 2-269)	Dismissed

31. Light-Duty Vehicle Greenhouse Gas Regulation beyond MY 2025 Requires Dialogue at the Appropriate Time.

In the Proposed Determination, EPA discussed the need for dialogue with stakeholders regarding light-duty vehicle GHG emissions reduction past MY 2025.[197] While the Alliance does not disagree that such dialogue is necessary at the appropriate time, now is the time for EPA to focus on understanding concerns with the MY2022-2025 standards as part of the Midterm Evaluation. As discussed at length above, the Midterm Evaluation process has been short-circuited in a way that has hindered the ability of stakeholders to comment effectively and to engage in a meaningful dialogue with EPA on the MY 2022-2025 standards. Before worrying about the MY 2026 standards and beyond, EPA should reinstate the Midterm Evaluation process to correct the many procedural deficiencies described above.

Conclusion

The Alliance strenuously objects to the Proposed Determination, both procedurally and substantively and reiterates its December 8, 2016 request that EPA either withdraw the Proposed Determination or extend the public comment period to a minimum of 120 days. The Alliance again requests the EPA to reverse course and return to the Midterm Evaluation process as originally envisioned. Withdrawing the Proposed Determination, or issuing an updated proposal in mid-2017 could avoid the appearance of an agency uninterested in a full, open, and fair consideration of all data and information bearing upon emissions standards that will profoundly affect the future light-duty automotive industry and market.

[197] *Id.* at 63.

Defour Group Response to EPA Rejoinders to Defour Group / Alliance of Automobile Manufacturers Submission Regarding the Regressivity/Affordability of EPA's Proposed Fuel Economy Standards

By Tom Walton PhD and Dean Drake

December 30, 2016

Defour Group Response to EPA Rejoinders to Defour Group / Alliance of Automobile Manufacturers Submission Regarding the Regressivity/Affordability of EPA's Proposed Fuel Economy Standards

The following submission by Defour Group LLC (Defour) on behalf of the Alliance of Automobile Manufacturers (Alliance) responds to the Environmental Protection Agency (EPA) "Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation"[1] rejoinders to Defour's September 21, 2016 comments, also submitted on behalf of the Alliance.[2]
As with the earlier submission, these comments are based on a broad consensus of research by mainstream economists on the benefits and costs of the nation's automotive fuel economy standards. Defour's September 21 comments drew three central conclusions:

1. Upward mobility for low-income households requires affordable and dependable personal on-demand transportation offered by used cars and light trucks.
2. The EPA's proposed 2022-2025 model year light-duty vehicle greenhouse gas standards are extremely costly and regressive – imposing the greatest costs as a percentage of income on the lowest income households who rely disproportionately on used vehicles.
3. The proposed standards will prove to be catastrophic for lower income and minority households. Contrary to popular opinion, fuel economy standards are much more costly and regressive than taxes on motor fuels, taxes that Congress has repeatedly rejected on grounds of excessive cost and disproportionately adverse, regressive impacts on low income households.

EPA replies that the concept of "access" to transportation is difficult to define and that the mobility provided by cars and light trucks is not the only way for low-income households to gain access to employment. EPA argues that the work by Mark Jacobsen that was the basis for Defour's conclusions regarding regressivity is based on the traditional flat-based fuel economy standards and that his findings are "mitigated" under the current footprint based standard. It notes that a recent paper by its consultant, David Greene, and co-authored by Jilleah Welch finds the standards to be progressive, not regressive.

We note that while "access" to employment and other economic and social necessities may be hard to define, more of it is preferred to less and that while there are other forms of transportation that can provide access for low-income households, the vast weight of mainstream economic research finds that personal, on-demand transportation provided by cars and light trucks, is critical to that effort.

[1] "Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards under the Midterm Evaluation." U.S. Environmental Protection Agency. EPA-420-R-16-020, November 2016.

[2] See Alliance of Automobile Comments on the EPA Draft Technical Assessment Report, September 26, 2016, Attachment 11, Docket ID EPA-HQ-OAR-2015-0827-4089.

We show that two other recent independent, mainstream studies find that the newer attribute-based standards are also regressive and costly. We show that unlike Jacobsen's work and the work of the two more recent studies, the paper by EPA consultant Greene and colleague Welch fails to separate the benefits and costs of binding fuel economy standards from those of non-binding fuel economy standards, confusing one with the other and rendering Greene and Welch's findings meaningless.

Most importantly, we show that both the EPA and Greene and Welch rely on a model that ignores the "opportunity costs" of binding standards – costs imposed on auto buyers and especially on low-income buyers when GHG/fuel economy standards deny them the opportunity to purchase vehicles with other attributes they value more highly than fuel economy gains.

We note that the EPA is unable to explain the so-called "energy paradox," or why consumers are unwilling to pay for many of the fuel-economy technologies that the EPA's engineering analysis finds to be cost-beneficial. Backed by independent, mainstream economic research at Brookings, Resources for the Future, Georgetown and elsewhere (including the EPA), we show that there is really no paradox at all and that EPA's "conundrum" is explained by a model that fails to take into account the opportunity costs imposed by binding standards. We note that the EPA's assumption of significant consumer undervaluation of the fuel economy savings that can result from technological advances in automotive fuel efficiency lies well outside the findings of mainstream economic literature and that it violates Office of Management and Budget's (OMB's) guidelines for conducting benefit cost analysis. We agree with mainstream economists that "perhaps the main failure of rationality is that of the regulators themselves."[3]

Defour/Alliance Conclusion #1: Upward mobility for low-income households requires affordable and dependable personal on-demand transportation offered by used cars and light trucks.

EPA Response: "The Alliance emphasizes the importance of access to transportation for low-income households for economic mobility. EPA agrees this is an important issue. At the same time, as discussed in the TSD Chapter 4.3.1, there is no commonly accepted definition of an acceptable level of access to transportation to which everyone should be entitled. Access to transportation does not only involve vehicles; it also may involve access to housing in locations with jobs, mass transit, and other forms of mobility."

[3] Ted Gayer and W. Kipp Viscusi, "Overriding Consumer Preferences With Energy Regulations," Working Paper 12-21, Mercatus Center of George Mason University, July 2012.

Defour/Alliance Rejoinder: EPA doesn't say whether or not it agrees or disagrees with Defour's summary of the mainstream literature regarding the importance of personal, on-demand transportation to the upward mobility of lower-income households. The vast weight of mainstream research finds that access to cars and light trucks is critical to the efforts of lower income and minority households to escape poverty. This is one of the reasons that most mainstream studies show that costly and regressive GHG reduction/fuel economy standards would impede such access.

On page 4-43 of the Technical Support Document, EPA defines their concerns about affordability thusly:

"Given the prevalence of heavily subsidized public transit systems, including free rides for vulnerable populations, it seems that societies often consider access to transportation in some sense a basic necessity. However, it is not clear how to identify the socially acceptable minimum level of transportation service. It seems reasonable to assume that such a socially acceptable minimum level should allow access to employment, education, and basic services like the grocery store, but it is not clear where consumption of transportation moves from practical to luxury."

While some can argue that there might be a state of "too much" mobility, it should be clear that the income line delineating a "practical" level of mobility from a "luxury" level of mobility lies well above the population we were discussing.

EPA appears to confuse the *relevant* question of the importance of access with an *irrelevant* question as to whether there is an acceptable definition of access, and then noting that other forms of transportation may also provide access to employment that is comparable to what light-duty vehicles have to offer.

To be sure, there is no "commonly accepted level of access to transportation to which everyone should be entitled." But that is not the question. It should go without saying that it is "commonly accepted" – indeed, *universally* accepted -- that greater access to the mobility provided by increased access to transportation is a positive economic, cultural, and social good.

The question Defour/Alliance poses is to what extent does the access to jobs provided by personal transportation – provided by cars and light trucks – benefit low-income households. It is a question of positive, fact-based economic inquiry. The issue is not whether or how much access these groups should or should not acquire, or if an "acceptable level" of mobility for these families and individuals can be defined. Rather, the studies cited by Defour show that there is a positive correlation between access to dependable personal transportation and the ability of low income households to improve their economic condition. This correlation should hold even if more access to mobility is provided; the question of how much access to mobility is too much does not apply to households in the lowest income categories.

EPA argues that personal, individually owned vehicles are not the only source of increased personal mobility. True enough. But, once again, that, too, is not the question.

Rather, the question concerns the importance of *personal* on-demand transportation: both absolutely and in relation to other forms of transportation and to other means of lifting low income and minority households out of poverty. The question is whether EPA agrees or disagrees with the findings of numerous mainstream economic studies regarding the critical importance of light duty vehicles to low-income and minority families in their efforts to find goods jobs, good housing, good schools, and to otherwise increase their upward economic and social mobility. Researchers across the political spectrum have produced a wealth of studies supporting the relationship between access to dependable vehicles and the ability of households to rise from poverty, such as:

- Wendall Cox and Ronald D. Utt of The Heritage Foundation: "It is easy to see why cars can help close the unemployment gap. At average transit operating speeds of 15 miles per hour, a maximum "job shed" of 175 square miles can be accessed in 30 minutes. In reality, however, the actual job shed would be much less because of the necessity of transfers and limited service areas. On the other hand, a person with an automobile can expect to average 30 miles per hour and reach a job shed of 700 square miles in 30 minutes. This vastly increases employment and other opportunities, offering a better quality of life."[4]
- Evelyn Blumenberg and Margy Waller of The Brookings Institution: "Most welfare recipients do not have access to a dependable automobile, and research indicates that lack of access to an automobile is one of the most prevalent barriers to employment. Research further indicates that car ownership improves the likelihood that low-income people will get and keep work, and improves access to better jobs." [5]
- Steven Raphael and Michael Stoll at The University of California at Berkeley: "Raising minority car ownership rates to the white car ownership rate would eliminate 45 percent of the black-white employment rate differential and 17 percent of the comparable Latino-white differential".[6]

[4] Wendall Cox and Ronald D. Utt, "Transit Advocates Want the Working Poor to Use Bikes and Buses, Not Cars," Heritage Backgrounder #1687, September 10, 2003. Emphasis added.

[5] Evelyn Blumenberg and Margy Waller, "The Long Journey to Work: A Federal Transportation Policy for Working Families," Center for Urban and Metropolitan Policy, Brookings Institution, July 2003, p. 12.

[6] Steven Raphael and Michael Stoll, "Can Boosting Minority Car-Ownership Rates Narrow Inter-Racial Employment Gaps?" Working Paper W00'002, Berkeley Program on Housing and Urban Policy, Institute of Business and Economic Research, Abstract.

- Margy Waller and Mark Alan Hughes of the Progressive Policy Institute, a research organization affiliated with the Democratic Leadership Council (of the Democratic Party): "In most cases, the shortest distance between a poor person and a job is along a line driven in a car. Prosperity in America has always been strongly related to mobility and poor people work hard for access to opportunities. For both the rural and inner-city poor, access means being able to reach the prosperous suburbs of our booming metropolitan economies, and mobility means having the private automobile necessary for the trip. The most important response to the policy challenge of job access for those leaving welfare is the continued and expanded use of cars by low-income workers."[7]

- Rolf Pendall, The Urban Institute, Evelyn Blumenburg, The University of California at Los Angeles, and Casey Dawkins, The University of Maryland, studying low-income families in 10 cities participating in two federal housing voucher programs:

  "Housing voucher recipients with cars tended to live and remain in higher-opportunity neighborhoods—places with lower poverty rates, higher social status, stronger housing markets, and lower health risks. Cars are also associated with improved neighborhood satisfaction and better employment outcomes. Among Moving to Opportunity families, those with cars were twice as likely to find a job and four times as likely to remain employed."

Defour/Alliance Conclusion #2: The EPA's proposed 2022-2025 model year light-duty vehicle greenhouse gas standards are extremely costly and regressive – imposing the greatest costs as a percentage of income on the lowest income households who rely disproportionately on used vehicles.

EPA Response: "The Alliance of Automobile Manufacturers (Alliance) and the National Automobile Dealers Association (NADA) cite Jacobsen (2013) for the regressivity of the standards. Jacobsen's finding of regressivity is based on a flat standard (i.e., not an attribute-based standard); because a flat standard provides incentives for small, efficient vehicles, lower-income households have lower benefits because vehicles are smaller than they would otherwise desire. On the other hand, comments from Levinson and Killeen at Georgetown University argue that the footprint-based standards are more regressive than flat standards because they provide incentives for bigger, more expensive vehicles. Unlike Jacobsen, the evidence offered by Levinson and Killeen does not consider consumer tastes for larger vehicles. These results, combined, suggest that the footprint-based standard, which is intended to maintain fleet size diversity valued by consumers, may mitigate any regressivity of the standards."

[7] Margy Waller and Mark Alan Hughes, "Working Far from Home: Transportation and Welfare Reform in the Ten Big States," Progressive Policy Institute, August 1, 1999. See also Anne Kim, "Why People Need Affordable Cars," Blueprint: Ideas for a New Century, February 11, 2003.

". . . In contrast, Greene and Welch at the University of Tennessee provide an analysis indicating that the standards are progressive--that is, they help low-income households more than they help higher-income households. . . .Similarly, they find, when the costs of fuel-saving technology are included, that all income groups gain from the technologies; savings relative to income decreases, indicating progressivity; and the highest total dollar savings go to middle-income households. They do not consider these results definitive."

". . . Greene and Welch (2016), cited above, find that used vehicle prices depreciate faster than use of vehicles. Because price depreciates faster than miles used, the payback period for a used vehicle should be shorter than for a new vehicle. This finding is consistent with Consumer Federation of America's (CFA) statements that owners of used vehicles will have higher mileage and lower operating costs. Because low-income households disproportionately buy used vehicles, CFA expects that those households will capture a disproportionate share of fuel savings from resold vehicles."

". . . The Alliance's Defour Group paper, based on the assumption of significant increases in used vehicle prices, argues that used vehicle prices will increase faster than the fuel savings. Greene and Welch present findings that vehicle prices depreciate at a somewhat faster rate than the decrease in VMT. If so, then the payback period for used vehicles should become shorter with reduced fuel consumption, because the up-front cost will decrease faster than fuel savings."

Defour/Alliance Rejoinder: Part 1. Recent Research Supports Jacobsen's Findings

In addition to Jacobsen's finding that the historical, flat-based GHG/fuel economy standards are costly and regressive, two very recent, independent and mainstream studies of the current footprint-based GHG/fuel economy standards also find the current, footprint-based standards to be costly and regressive.[8] The latter studies consist of research by Professor Arik Levinson of Georgetown and the National Bureau of Economic Research (NBER) and a joint study performed by University of California, Berkeley Professor Lucas Davis and Massachusetts Institute of Technology (MIT) Professor Christopher Knittel. Their work provides powerful confirmation of Jacobsen's findings that, in the words of Professor Levinson, the standards "disproportionately burden lower income households" and "make poor households worse off."[9]

Nevertheless, because Levinson finds that for any given model year, the footprint-based standards reduce the bias against the larger vehicles that low-income and other used car buyers prefer, EPA contends that the more recent findings of Professor Levinson, in particular, "mitigate" any regressivity that Jacobsen may have found in his study of the traditional flat standard.

[8] Arik Levinson, "Are Energy Efficiency Standards Less Regressive Than Energy Taxes?" October 17, 2016, at http://faculty.georgetown.edu/aml6/pdfs&zips/RegressiveMandates.pdf and Lucas Davis, and Christopher Knittel "How Regressive are Fuel Economy Standards?" Working Paper, Haas School of Business, University of California, Berkeley; Energy Institute at Haas and Sloan School of Management, Massachusetts Institute of Technology December 2016.

[9] Arik Levinson, op. cit. October 17, 2016, page 2

To be sure, within a given model year, the bias against the kinds of larger and less fuel-efficient vehicles that used car buyers prefer will be mitigated. But over time as the standard becomes progressively, indeed, exponentially more stringent, fewer and fewer large and fuel efficient used vehicles will be available, increasing their cost both absolutely and relative to the costs of smaller and more fuel efficient vehicles. These trends not only strengthen Levinson's results, they also validate and strengthen Jacobsen's methodology and findings.[10]

Most importantly -- indeed, decisively -- Levinson finds the current footprint-based standards also to be regressive, as does the other study by mainstream economists Lucas and Knittel.[11] Levinson, in particular, finds that "the richest households have more than 10 times the income as poor households, and would pay only about three times as much [for a an increase in a footprint-based standard that would save as much fuel and reduce as much carbon as 'a $0.29 cents per gallon carbon tax']."[12]

Levinson concludes that no matter how the regulators choose to configure the standards – flat- or footprint-based-- GHG/fuel economy vehicle mandates impose costs that exceed the benefits and that they are imposed disproportionately on low-income households.

Defour/Alliance Rejoinder, Part 2: The Footprint Based Standards Adopted in 2011 Are More Regressive and Costly than the Historical Flat-based Standards

Levinson finds that, contrary to EPA's assertions, "the switch [in 2011] to footprint based *exacerbated* the regressivity of the CAFE standards."[13]

It should also be noted that Jacobsen finds that the switch to a footprint-based standard has *increased* the costs relative to a flat-based standard. Not only is the footprint standard more regressive than the flat standard for any given level of greenhouse gas emissions reductions or fuel savings, it is also more costly.

Jacobsen notes that "the used fleet will never fully reflect improvements in new car fleet economy." He notes that this is "due to changing scrap rates," which "creates a used car fleet weighted more heavily toward large vehicles, and with a correspondingly low average fuel economy relative to new cars." This is the fleet – mainly a fleet of 15- to 20-year old and older cars and light trucks -- that is available to low-income households seeking to find jobs and otherwise improve their economic and social well-being.

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[10] While Levinson notes that footprint standards make it harder for small vehicles to meet the standards than larger vehicles, he finds that the predominant driver of regressivity is less driving and lower vehicle ownership by poorer than wealthier households. He in fact does consider tastes, finding, consistent with Jacobsen's research, that within a given stringency of standards, that larger efficient cars are favored more than smaller inefficient cars.

[11] *Id.*

[12] Levin, page 12.

[13] Levin, page 3., emphasis added. As Lucas and Knittel note, The reason is that Levinson "finds that high-income households tend to buy higher footprint vehicles, so they do relatively better under footprint based standards, and thus footprint-based standards are even more regressive than regular standards."

In other words, and as pointed out in Defour's September 21 comments on the EPA's Draft Technical Assessment Report, relative to a no-standard baseline, mandated and binding increases in the GHG/ fuel economy standards permanently condemn low-income households to higher upfront vehicle purchase costs in order to get the larger, more powerful and less-fuel efficient vehicles they require.

Defour/Alliance Rejoinder, Part 3: GHG/Fuel Economy Standards Have Significantly Increased the Prices of the Older Vehicles on Which Low-Income Households Depend

EPA disputes these findings, arguing that there is no evidence that the standards increase the price of either new or used vehicles. But EPA's argument is based solely on new and used vehicle price trends without controlling for changes in other explanatory variables such as technological advance and the level of fuel prices. They ignore the evidence not only provided by Jacobsen, but also by every mainstream economic study that controls for such factors, as pointed out in Defour's September 21 submission.

EPA argues that used as well as new car prices have not risen following the ramping up of fuel economy standards in 2008.[14] In fact, both new and used vehicle prices – the focus of Jacobsen's analysis – have risen since that time, reversing a sharp downward spiral prior to 2008.

The impact on the kinds of used vehicles that lower-income buyers require has been especially adverse. Edmunds, for example, recently reported that "used in-demand vehicles are especially vulnerable to price increases as consumers look for cheaper alternatives to new vehicles." Jessica Caldwell, Edmunds Executive Director of industry analysis, notes that the 2016 average transaction price of new vehicles has increased by 2.7 percent from 2015 "to an all-time high of $34,077 per vehicle." (The estimate exceeds the 1.6% year-over-year increase in overall inflation as according to the BLS.)

[14] EPA also argues that new and used vehicle price trends have followed a steady, monotonic downward path both before and after the fuel economy standards were tightened in 2008. They note that Defour utilized nominal price trends to rebut this assertion. However, Defour's finding also stands when allowing for inflation-adjusted pricing trends. From 1995 to 2008, when the standards were not biding for new cars and barely binding for light trucks, the real or inflation-adjusted price of new vehicles fell by 33% and 42 % respectively, while following the sharp increase in the standards in 2008, new car and light truck prices as adjusted for inflation rose by 1% from their October 8 recession low and used car and light truck prices rose by 8% from their April 2009 recession low. As noted in the Defour submission; such sharp reversals of existing trends are not in and of themselves dispositive as many other factors such as the pace of technological progress and the state of the economy influenced their direction and change. The only data that matter are those which are drawn from the cited mainstream studies and which control for these other factors. Note: we used the cpi-chained index to adjust data in the period from 2008 to 2016. As the Bureau of Labor Statistics observes, it is the superior index for making such adjustments because, unlike the unchained index, it allows consumer substitution at the higher levels of aggregation. See United States Bureau of Labor Statistics, "Frequently Asked Questions about the Chained Consumer Price Index for All Urban Consumers (C-CPI-U)," at http://www.bls.gov/cpi/cpisupqa.htm.

Caldwell also notes that the "higher prices are putting a bit of a squeeze on the market for lower-cost, used vehicles" and that "Edmunds data shows that more people are looking for affordable vehicles [on Edmunds.com] than are actually sold, driving up values and demand."

To be sure, as noted in Defour's September submission; such sharp reversals of existing price trends are not in and of themselves dispositive as many other factors such as the pace of technological progress and the state of the economy influence their direction and change. The only data that matter are those which are drawn from the cited mainstream studies, which control for these other factors, and all of which confirm the adverse, upward impact of GHG/fuel economy standards on new, and especially used car prices.

EPA also cites a fourth, also recent study by David Greene and Jilleah Webb of the Howard H. Baker Junior Center for Public Policy, a study which Greene and Welch characterize as "inconclusive," but that finds the standards to be progressive.[15] The EPA finds this argument appealing, in part, because Greene and Welch "find that used vehicle prices depreciate faster than use of vehicles." EPA argues that "because [used vehicle] price depreciates faster than miles used, the payback period for a used vehicle should be shorter than for a new vehicle" and that "because low-income households disproportionately buy used vehicles . . . those households will capture a disproportionate share of fuel savings from resold vehicles."

But the regressivity of today's footprint fuel economy standards has nothing to do with the relative depreciation and use rates of used versus new vehicles. Rather, as Levinson finds, it is caused by a combination of less driving, and lower vehicle ownership by low-income versus high-income households.[16] This necessarily means that the increased cost of used vehicles occasioned by the proposed mandates will *increase* the required payback period for low-income households; that is, for those who are fortunate enough to still be able to afford the purchase of a car or light truck.

It is also important to understand that Greene and Welch's analysis conflates – mixes together – the impact of fuel economy increases caused by the standards with the impact of fuel economy increases driven by consumer demand in the marketplace. For that reason, it is not possible to derive from their work the net effect of mandates as opposed to markets. When increases are market-driven, the standard is not binding and the costs (net of benefits) of the standard are zero, in which case the issue of regressivity is moot. Conflating the costs of mandates with the benefits of consumer-driven increases in vehicle fuel economy tells us nothing about the regressivity of the standard, footprint or flat. Nor does it say anything about any impact on payback periods.

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[15] David Greene and Jilleah Welch (2016). "The Impact of Increased Fuel Economy for Light-Duty Vehicles on the Distribution of Income in the United States." University of Tennessee Baker Center Report 5:16, Docket EPA-HQ-OAR-2015-0827-4311.

[16] Levinson, page 12.and Table 2.

Most importantly, and as Levinson emphasizes, Greene and Welch start with the assumption that the fuel economy standards have *negative* (net) costs (positive net benefits), in which case the question of regressivity is, once again, moot: under their analysis everyone necessarily benefits regardless of income.

This is important because, as pointed out in Defour's September 21 submission, Greene and Welch's assumption of negative (net) costs of binding mandates goes against the vast weight of mainstream economic research. Mainstream economic studies find that mandated binding increases in GHG/fuel economy standards, regardless of their level of stringency, impose costs on auto buyers that exceed the benefits. These studies further find that increases of the magnitude EPA and NHTSA would set, will impose costs that vastly outweigh the benefits. And, as we have emphasized, all three extant and mainstream studies of regressivity find those costs – the costs of mandated increases – are disproportionately borne by lower income households.

Defour/Alliance Rejoinder, Part 4a: EPA's Rejoinder is Based on an Incomplete Model of Consumer Choice

Greene and Welch's findings beg the question: Why do their estimates, as well as those of the EPA and NHTSA in their Benefit Cost Analyses, lie so far outside the mainstream of economic research? The reason is that the Greene/EPA/NHTSA research methodology zeroes out the opportunity costs incurred by auto buyers when command-and-control regulations prevent these consumers from getting other desired vehicle attributes of greater value than that of fuel economy increases – such attributes as vehicle size, performance, and safety. Their "engineering models" do not incorporate the very substantial consumer welfare losses – a.k.a. "opportunity costs" when standards deny consumers these options.

The EPA, relying in part on a survey article by consultant Greene, argues that while in theory there could be such opportunity costs – that, in EPA's words, "adoption of these technologies [could] produce hidden costs (i.e. involves tradeoffs with other vehicle attributes valued by consumers)," (page A-54), "to date," they "have not found evidence of inherent "hidden costs" of the technologies to vehicles." (EPA, page A-61)

EPA thus rejects the methodology of the majority of mainstream economic studies that, faced with limited incomes, rational auto buyers might not want to spend their money on fuel economy technologies. EPA argues that because their estimates show all of the proposed technologies "pay for themselves" there is no need for buyers to "trade off" the gains made possible by technological advances that increase fuel efficiency against other vehicle attributes that consumers with limited budgets might prefer. (EPA, page A-60). While EPA allows that such tradeoffs are possible in theory, it contends it has "included the costs of avoiding [such] adverse effects in their estimates." EPA further argues that the standards could "induce major innovations that may be used in part to mitigate those opportunity costs and . . . lead to ancillary benefits to consumers."

EPA further argues that professional automobile reviewers, "who have experience evaluating technologies and are expected to identify any potential drawbacks to consumers i.e., hidden [opportunity] costs if they exist," find that many, if not most of existing, fuel economy technologies now in use are good values for their readers. EPA notes that it performed two detailed studies of positive vs. negative professional reviews and found that "across all vehicle characteristics, there are more instances of fuel-saving technologies associated with lower probabilities of negative evaluations of characteristics than with increased negative evaluations" and that the negative evaluations can result from "faulty implementation" rather than a problem inherent to the technology. (pages A-55 and A-55 to A-60).

EPA notes that Consumers Union finds "a statistically positive correlation between rated fuel economy and overall satisfaction with the vehicles, controlling for year, mechanical problems, price, acceleration and CR's Road Test Score." (page A-61).

EPA points to the results of a survey it commissioned by Professor Greene that concluded that there is a wide range of estimates of consumers' willingness to pay (WTP) for alternative vehicle attributes, and argues that this renders any estimates of opportunity costs that economists use in the benefit/cost analyses to be unreliable as the basis for any reliable estimates of their magnitude.

EPA acknowledges that it is puzzled by consumers' failure to purchase the fuel efficiency technologies that pass their benefit-cost tests in the absence of a government mandate – the so-called "energy efficiency paradox" – but attribute this "conundrum" mainly to consumers' irrational undervaluation of the fuel economy gains that such technologies can deliver.

EPA claims that the mainstream economic research Defour cited in its September comments is based on outdated estimates of costs and benefits.

Defour/Alliance Rejoinder, Part4b: EPA Excludes Consumer Tradeoffs Among Vehicle Attributes

Each of EPA's arguments portrays an incomplete understanding of the concept of economic tradeoffs and opportunity costs. As noted by economists at Resources for the Future, Brookings, MIT, the Congressional Budget Office, most mainstream think tanks, and universities, and as explained in detail in Defour/NADA's comments on the proposed standards in February 2012, the issue is not just how valuable any specific fuel economy technology might be in and of itself or whether such a technology "pays for itself." Rather, for the consumer, the issue is whether or not the money spent on improved fuel economy could be better spent on other vehicle attributes such as utility and durability.

Even if the value of fuel savings of each and every one of the proposed fuel efficiency technologies were to outweigh their upfront costs – a claim Defour vigorously challenged in its 2012 submission on behalf of the NADA - auto buyers might nonetheless prefer to spend their limited incomes on other vehicle attributes that consumers find to be still more valuable than the value of fuel economy enhancements that those technological advances might make possible.

Auto buyers may prefer to spend their money on technologies that are fuel neutral (e.g., on technologies that enhance connectivity), on technologies that necessarily increase fuel consumption (e.g., on 4-wheel instead of 2-wheel drive), or, most importantly, on technologies that could be used to increase fuel economy but that buyers prefer instead to utilize to enhance other attributes such as increases in interior volume, performance, or safety.

It is this latter tradeoff or "opportunity" – the chance for consumers to utilize advanced fuel efficiency technologies to achieve objectives other than fuel economy gains even when the technology "pays for itself" -- that the EPA fails to address. It is just as important as the possibility that auto buyers' might not want to purchase a particular fuel efficiency technology in the first place.

Indeed, it is the *key* to understanding why EPA's responses to the Defour/Alliance commentary are not supported by mainstream economic analysis.

To quote the Congressional Budget Office:

"Vehicles' current level of fuel efficiency most likely reflects consumers' trade-offs between fuel economy and other characteristics that drivers want, such as vehicle size, horsepower, and safety. The same technologies that can be used to boost fuel economy can be used to hold fuel economy constant while increasing the vehicles weight, size, or power. . . . Raising CAFE standards would impose costs on both consumers and automobile producers by forcing improvements in fuel economy that car buyers may not want."[17]

As Defour noted in its February 2012 submission on behalf of the National Automobile Dealers Association, there are many real-world illustrations of this critical insight. For a diagrammatic exposition of this fundamental insight, please see the Appendix to the present paper, which is reproduced from that submission.

As we noted, the European experience with diesel technologies in the period prior to the implementation of their GHG/fuel reduction mandates – a period when high fuel taxes and thus fuel prices well above even the levels assumed in the EPA benefit/cost analysis, not to mention today's much lower levels – were the drivers for consumer-driven fuel economy gains, and provides a striking illustration of what happens when consumers prefer to spend their money on attributes other than fuel economy.

[17] Congressional Budget Office, *Reducing Gasoline Consumption: Three Policy Options* (November 2002*)*, Chapter Two, page 10.

It is so informative because it occurs not only in the presence of such high fuel prices, but even when the value of the fuel savings benefits associated with fuel-efficient technologies exceed the upfront vehicle costs of the technology – even when, in the EPA's words, "the technology pays for itself."

Lee Schipper et al found that while diesel cars and light trucks sold in Germany in 2006 "had a technical advantage of 15% less CO_2 emissions per kilometer than gasoline-powered cars and trucks, the purchase of larger diesel vehicles virtually offset all of this advantage." They noted that some, but not all of this difference could be explained by self-selection, with people already planning to buy larger cars choosing diesels.[18] Whatever the exact breakdown, this example shows that even if, in the presence of heavy subsidies and incentives and fuel prices well in excess of those assumed in the EPA benefit/cost analysis, and even where consumers are willing to purchase vehicles with technologies providing potential fuel economy increases of 25% and more and with carbon dioxide emissions reductions of 15% and more, they nonetheless preferred to spend most of their limited budgets on improving performance and increasing size, instead of on reducing fuel consumption.

Increased size is not the only alternative available to auto buyers. Consumers may also prefer to take some or all of the improved hybrid fuel efficiency gains as improved performance. In that case, as President Clinton's Assistant Secretary of Energy for Domestic and International Affairs and former Brookings Senior Fellow, David Sandalwood, observed, "The fact that an engine is a hybrid does not necessarily mean it will achieve substantial fuel savings." This is because, in his words, "hybrid technology can also be used to improve acceleration," so that the net result could be only "somewhat better fuel efficiency than the standard internal combustion engines."[19]

General Motors' experience with light truck technology enhancements provides yet a third illustration of this phenomenon. When General Motors introduced a redesigned MY 2000 full-size pickup that increased full-size fuel economy by about 1 mpg, the company's product planners hoped that this would increase GM's light truck CAFE by 0.4 mpg versus the 1999 MY. But sales of full-size pickups increased by about 150,000 units in the 2000 MY, leading to a *decline* of 0.1 mpg for the overall light truck fleet. Light truck purchasers had chosen to take even more than the increase in fuel efficiency *not* in the form of increased fuel economy, *but rather* as larger payload and, in this case, towing capacity.

Each of these examples involved fuel economy technologies that, arguably, passed a benefit-cost test under the EPA's "engineering" methodology: the technologies "paid for themselves" in that the value of the potential fuel savings exceeded the cost of the fuel economy hardware.

[18] The authors also found that higher mpg diesel cars were driven 40 100% more than gasoline powered cars, but some of this was attributable to lower diesel fuel prices See, L. Schipper, Marie-Lilliu, and L. Fulton, "Diesels in Europe: Analysis of Characteristics, Usage Patterns, Energy Savings and CO2 Emission Implications," *Journal of Transport Economics and Policy*, 2002, 36(20), pages 305-340

[19] David Sandalow, *Freedom from Oil: How the Next President Can End the United States' Oil Addiction*, Brookings (2008).

But mandating that consumers take all of the increase in fuel efficiency in the form of increased fuel savings would not have passed the economist's cost-benefit test: it would not have offered rational auto buyers the biggest "bang for the buck" – it would not offer them the most value for their money. Forcing these consumers to forego those other more highly valued attributes -- attributes that provided still greater net (present value) benefits, still greater rates of return on their investments, and still shorter payoff periods per dollar spent out of their limited budgets as they themselves evaluated these alternatives -- would have made them worse off. And this is so even if the EPA's engineering analysis (correctly) concluded that their (and the auto manufacturers' investments in increased fuel economy) yields a positive "net present value."

Put another way, "energy efficiency," the single-minded objective of the EPA, does not equate to "economic efficiency." To quote Richard Newell, former Administrator for the Energy Information Administration, in his study of consumer choice in the market for household appliances, which insight applies with equal force to automobile and other durable consumer goods:

"Requiring consumers to purchase appliances with a higher level of efficiency based on a simplistic analysis could, in effect, impose extra costs on consumers. The result might be a higher level of energy efficiency but decreased economic efficiency, because consumers could be forced to bear costs that they had otherwise avoided."[20]

Unlike Greene and the EPA, mainstream economists include estimates of these opportunity costs in their benefit/cost analyses of fuel economy mandates. This, more than anything else explains why Greene and the EPA find positive net benefits in their *engineering* analyses, while mainstream researchers find negative net benefits in their *economic* analyses – costs that disproportionately impact the lowest income households.

Defour/Alliance Rejoinder, Part 4c: There is No "Energy Efficiency Paradox"

EPA acknowledges that it is unable to satisfactorily explain why consumers are unwilling to purchase many of the fuel efficiency technologies that pass the EPA's benefit-cost tests in the absence of a government mandate – the so-called "energy efficiency paradox." While EPA acknowledges that the evidence is contradictory, it nonetheless attributes this "conundrum" to consumers' irrational undervaluation of the fuel economy gains that such technologies have to offer. (EPA, pages A-27 to A-32)

[20] Richard G. Newell, "Balancing Policies for Energy Efficiency and Climate Change," *Resources*, Summer 2000, pages 15-16 (Emphasis added).

EPA cites a recent literature review by its consultant, Greene et al. The review is a follow-up on an earlier, similar review, which Defour critiqued in its 2012 response to the proposed 2017-2025 Model Year standards and where we cited seven major deficiencies in that analysis, and to which the EPA does not respond.[21] This time, Greene appears to have scaled back from his earlier findings, arguing instead that there is not enough information to determine the extent to which opportunity costs should be considered in benefit cost analyses.

EPA argues that while opportunity costs – the tradeoffs between fuel economy and other vehicle attributes of value – are possible in theory, EPA has "included the costs of avoiding [such] adverse effects in their estimates" and that the standards could "induce major innovations that may be used in part to mitigate the opportunity costs." But as just noted, by ignoring, instead of estimating and including the opportunity costs, the EPA has not assessed the full costs of the standards. EPA cannot address these costs if they don't know what they are.

Dr. Ted Gayer, the Joseph A. Pechman Senior Fellow at the Brookings Institution and co-director of the Brookings Institution's Economic Studies Program, and Vanderbilt University Distinguished Service Professor, Kipp Viscusi, commenting on the benefit/cost analysis used by the EPA to justify its proposed Model Year 2017 to 2025 standards, wrote:

"Even if EPA and NHTSA could demonstrate some form of consumer choice failure, these choices would need to be completely flawed to warrant counting the entirety of the private savings as net economic benefits. . ..

"Choosing a car other than a Toyota Prius, a Nissan Leaf, or a Chevrolet Volt is not an inexplicable quirk of individual behavior but generally stems from valuation of car attributes these models do not offer. . ..

"The economic puzzle . . . is why consumers are this remiss. How can it be that consumers are leaving billions of potential economic gains on the table by not buying the most energy-efficient cars? Moreover, how can it also be the case that firms seeking to earn profits are likewise ignoring highly attractive opportunities to save money? If the savings are this great, why is it that a very basic labeling approach cannot remedy this seemingly stunning example of completely irrational behavior? It should be quite simple to rectify decisions that are this flawed.

"It should be a red flag that something is amiss with an analysis that assumes such perplexing consumer and firm behavior that runs counter to the most rudimentary economic theory [See the Appendix to this submission for a diagrammatic exposition of the "rudimentary theory"] and our general sense that we do not live in a world in which people never make sound choices. [On the other hand] it might be that there is something that is incorrect or perhaps even irrational in the assumptions being made in the regulatory impact analyses. Indeed, upon closer inspection it is apparent that there is no empirical evidence provided for the types of consumer failures

[21] Thomas F. Walton and Dean Drake, "Willingness to Pay for MY 2025 Model Fuel Economy Standards: Government Estimates Vs. Economic Reality," February 2013, 2012. The study was commissioned by the National Automobile Dealers Association.

alleged. Even if some consumers do sometimes fall short on certain dimensions of choice, the magnitude and prevalence of such a shortfall is important and is never addressed in the regulatory assessments. Nor is there adequate consideration of the actual and potential role of informational remedies that have already been adopted."

Gayer and Viscusi then conclude:

"Perhaps the main failure of rationality is that of the regulators themselves. Agency officials who have been given a specific substantive mission have a tendency to focus on these concerns to the exclusion of all others. Thus, fuel efficiency and energy efficiency matter, but nothing else does. If other attributes matter, it is assumed they either are irrelevant or will be included at no additional cost in the post-regulation products. In effect, government officials act as if they are guided by a single mission myopia that leads to the exclusion of all concerns other than their agency's mandate."[22]

Consider as well the findings of the Congressional Budget Office in a 2002 study commissioned by the Senate and regarding the impact of proposals for earlier, much less stringent increases in the standard. The CBO, noting that many proponents of increased fuel economy standards were arguing that the market for fuel economy is inefficient because consumers either "lack information about vehicles' fuel efficiency (in other words they do not know what's best for them) or that producers lack an incentive to respond to consumers' preferences for fuel efficiency." The CBO concluded:

"Most economists do not believe that either assumption is valid. Vehicles' current level of fuel efficiency most likely reflects consumers' trade-offs between fuel economy and other characteristics that drivers want, such as vehicle size, horsepower, and safety. The same technologies that can be used to boost fuel economy <u>can be used to hold fuel economy constant</u> while increasing the vehicles weight, size, or power. Thus, the fact that producers have done the latter rather than the former in recent years suggest that they have responded to buyers' preferences by targeting available technologies toward other features that consumers desire. Raising CAFE standards would impose costs on both consumers and automobile producers by forcing improvements in fuel economy that car buyers may not want."[23]

[22] *Gayer and Viscusi*, page 26. See also, as Paul Portney, former head of Resources for the Future, concluded with his RFF colleagues in the leading survey journal of mainstream economics: *"Perhaps it is not that consumers misperceive or overly discount fuel saving benefits, but rather that engineering studies underestimate the true economic costs of actually adopting fuel-saving technologies.* The true economic cost is probably larger than the engineering cost estimates . . . for two reasons. First, it ignores the possible opportunity cost of not using fuel saving technologies for other vehicle enhancements. That is, by forcing automakers to apply their technical expertise to more fuel-efficient engines, tighter CAFE standards could mean fewer of the improvements to which consumers have responded enthusiastically in the past – including such things as enhanced acceleration, towing capacity and so on. It is the implicit value of these foregone improvements that ought to be compared with the fuel economy savings that tighter CAFE standards would bring."[22]

[23] Congressional Budget Office, "A CBO Study: Reducing Gasoline Consumption: Three Policy Options (November 2002), Chapter 2, page 2. (Emphasis added)

It is also important to note that the subset of the population on which our comments focus – low income households – have a much different set of economic priorities than the general population when it comes to transportation. EPA's assumed net benefits from more stringent standards are the difference between a higher up-front purchase cost and the present value of a stream of benefits (fuel savings). In that sense, fuel economy standards are a classic investment paradigm – a lump sum payment now that yields a stream of future dividends. People at the lowest income levels, however, have no extra money to invest.

As the studies, we have presented suggest, the people in this population need dependable transportation just to generate the income for basic needs and have little money to invest in that purchase. Any upward pressure on the purchase price of vehicles as a result of more stringent standards will, depending on the particular situation, force low income buyers to sacrifice other needed attributes of importance such as reliability, carrying capacity, safety, towing capacity, and many other attributes unique to their particular situations.

Defour/Alliance Rejoinder, Part 4d: EPA's Benefit/Cost Estimates Lie Well Outside the Mainstream

EPA references two specific studies of consumer evaluation: one that finds no under-evaluation and another that finds that consumers take into full account only 75% of the value of fuel economy gains achievable through fuel efficiency advances.

But, as we noted in our September 2012 submission, mainstream economic research, including that at the EPA itself, finds that even if consumers were to irrationally undervalue fuel savings, the undervaluation would have to be truly massive in order to justify even the much less stringent 2012 to 2016 Model Year regulations currently in place.

Indeed, Gayer and Viscusi find that of the EPA's $613 billion over-estimate of the benefits for the 2017-2025 Model Year standards, 87 percent are estimated to be private benefits to U.S. consumers, including $444 billion in estimated lifetime fuel savings, $71 billion for the value of increased driving, and $21 billion in refueling time value. Just $3.2 to $10.7 billion derives from GHG reduction benefits, with other EPA-estimated benefits from reductions in criteria pollutants at $8 billion and enhanced energy security at $24 billion.

This means that the benefits of the proposed standards, exclusive of those derived from its assumption of the $444 billion in fuel savings that consumers are unwilling to pay for, are outweighed by EPA's estimate of $192 billion in hardware costs, a deficit exceeding $55 billion and this is taking EPA's cost estimates as a given. Defour found in its 2012 submission that actual hardware costs at the consumer level were 60% higher than EPA's estimates, even when adopting EPA estimates of the underlying manufacturing costs.[24]

[24] *Id*, and Michael Whinihan, Dean Drake, and David Aldorfer, "Retail Price Estimates and Incremental Cost Multipliers: Theory and Reality," February 2012, Defour LLC, for the National Automobile Dealers Association.

Defour also found, based on research by economists at the Massachusetts Institute of Technology, that consumers would be willing to pay for only about 25% of the fuel economy savings generated by the mandated fuel efficiency technologies at retail fuel prices around $4.25 per gallon ($2016), and that they would be willing to pay for none of the fuel economy savings that might be generated from the mandated fuel efficiency technologies at or below around $2.30 per gallon ($2016) – the EIA's estimate of retail gasoline prices for 2017.[25]

Gayer and Viscusi conclude:

"With estimated costs of the regulation of $177 billion by NHTSA and $192 billion by EPA, this regulation clearly fails a [benefit / cost analysis] without the presumption of consumer irrationality and the resulting [estimated] substantial private benefits of mandating more fuel-efficient vehicles."[26]

In our September 2012 submissions, we also noted that earlier studies at Resources for the Future and the Congressional Budget Office (CBO) of far less stringent proposed standards came to similar conclusions, finding that mandating binding fuel economy increases would impose very substantial welfare losses on consumers and on the broader economy. We also noted that the EPA's own analysis estimated net negative social or externality costs – with increased safety and traffic safety externality costs resulting from the proposed standard exceeding the value of reduced GHG emissions and energy security savings.[27] We noted that these conclusions, as well as those of a vast economic literature, were supported by a survey of mainstream research by economists at Resources for the Future and which was published in the *Journal of Economic Literature*, a journal of the American Economic Association and the leading survey journal for economic scholars. The authors concluded:

"Whether higher fuel-economy standards would increase or reduce efficiency or have little effect remains unsettled. Kleit (2004) and Austin and Dinan (2005) find that costs from binding increases in standards of 3–4 miles per gallon would cost around $3–4 billion or more, assuming market adoption of all privately cost-effective technologies. <u>Higher fuel-economy standards significantly increase efficiency only if carbon and oil dependence externalities greatly exceed</u>

[25] Walton and Drake, page 10.

[26] Gayer and Viscusi., page 21.

[27] See, in particular, Fischer, Harrington, and Parry, "Should Corporate Average Fuel Economy Standards (CAFE) be Tightened?" *Energy Journal* (2007) at http://www.rff.org/documents/RFF-DP-04-53-REV.pdf at and Harrington, Parry, and Walls, "Automobile Externalities and Policies," *Journal of Economic Literature (2007), and* David Austin and Terry Dinan, "Clearing the Air: The Costs and Consequences of Higher CAFE Standards and Increased Gasoline Taxes," *Journal of Environmental Economics and Management* (2005), and William Pizer, Dallas Burtraw, Winston Harrington, Richard Newell, and James Sanchirico, Modeling Economy wide versus Sectoral Climate Policies Using Combined Aggregate-Sectoral Models." The energy journal: Energy Economics Educational Foundation Inc.- Boston, Mass. [u.a.]: Oelgeschlager, Gunn & Hain, ISSN 0195-6574, ZDB-ID 8643192. - Vol. 27.2006, 3, p. 135-168. and David Sandalow, *Freedom from Oil: How the Next President Can End the United States' Oil Addiction*, Brookings (2008). *The Journal of Economic Literature* article is a survey of the leading economic studies in the field, Emphasis added.

the mainstream estimates in Table 2, or if consumers perceive only about a third of the actual fuel-economy benefits" (Fischer, Harrington, and Parry 2006).[28]

Defour/Alliance Rejoinder, Part 4e: Behavioral Psychology Does Not Justify EPA's Views on Consumer Choice

As noted above, EPA and NHTSA cite literature in behavioral economics to the effect that there can be systematic consumer biases against rational decision-making. Gayer and Viscusi counter: "Among the list of justifications for the "paradox" are acknowledgements that it could be a consequence of EPA's miscalculation or omitted variables, in that "factors such as transaction costs and differences in quality may not be adequately measured" and "there is likely to be variation among consumers in the benefits they get from improved fuel economy." The behavioral justifications offered by NHTSA and EPA offer very little evidence that consumers are causing self harm in their vehicle-purchasing decisions and would thus accrue private benefits by having their options restricted .... [29]

Defour/Alliance Rejoinder, Part 4f: EPA Fails to Consider Less Costly and More Effective Alternatives

Gayer and Viscusi note that "Executive Order 12866 (signed by President Clinton and re-affirmed by President Obama in his Executive Order 13563) requires each agency to 'identify and assess available alternatives to direct regulation . . . such as . . . providing information upon which choices can be made by the public.'" If consumer irrationality and ignorance is the issue as EPA contends, the better approach might be to issue a regulation requiring better information.

Gayer and Viscusi ask:

"Why a rigid mandate is warranted rather than an informational regulation that would provide consumers with the guidance to make sounder choices. Indeed, in 2011 EPA did just that by issuing its Motor Vehicle Fuel Economy Label Final Rule. The mandated label for all new cars is quite extensive, including an overall mpg rating, a city mpg rating, a highway mpg rating, gallons/100 miles, driving range on a tank of gas, fuel costs in five years versus the average new vehicle, annual fuel costs, fuel economy and greenhouse-gas rating, and smog rating.

"These components of the label address the purported behavioral failures in that they (i) indicate the longer-term fuel costs, thus diminishing the effect of high discount rates, (ii) make the benefits of fuel economy salient and a less "shrouded" attribute, (iii) provide easy calculations of fuel economy, (iv) enable consumers to know the actual fuel-economy benefits rather than relying on rough rules of thumb, (v) make it clear that fuel economy is a valued vehicle attribute not a proxy for a less-expensive vehicle, (vi) make it easier for consumers to identify which vehicles provide fuel economy, (vii) provide diverse measures of fuel economy

[28] Harrington et al, *Ibid*.

[29] G&V, page 23.

that consumers can relate to their driving style, and (viii) make the fuel costs more apparent as an upfront cost similar to that of the sticker price.

"Indeed, the EPA label rule is directed at remedying all but a couple of the types of consumer choice failures that EPA claims account for the private benefits of fuel-economy standards. What is striking about the EPA analysis of the CAFE standard is that the EPA regulatory impact analysis does not even mention the existence of the agency's own new label rule."

They note, "This oversight goes to the heart of the CAFE standard analysis, as most of the benefits needed to justify the regulation relate to consumer choice failures targeted by the new labeling rule. If the label rule does not have zero economic benefits, then the EPA analysis of the fuel-economy standard necessarily overstates the benefits associated with the proposed CAFE standards. If the label rule is completely worthless and generates no benefits for consumer choice, then EPA was remiss in issuing the regulation and the OMB, the watchdog over all major new federal regulations, was remiss in permitting the agency to move forward with a rule other EPA assessments implicitly treat as worthless.

"We take an intermediate view with respect to the labeling regulation. Informational strategies have a productive role to play and should be the primary policy instrument used if the alleged market failure stems from a lack of information. Before EPA should consider other, more intrusive forms of intervention, it should demonstrate that private decisions are flawed and that informational remedies will not suffice. In general, agencies should examine less-restrictive regulatory alternatives before adopting highly intrusive technology-forcing standards. The proposed EPA fuel-economy label rule is not ideal, as Cohen and Viscusi discuss, but it is far superior to restricting the choices available to consumers. That a particular labeling approach may fall short should serve as an impetus for developing more effective informational policies rather than abandoning all labeling regulations because the particular policies implemented were not designed as well as they could have been. Informational regulations remain highly attractive, as they use a form of intervention that does not attempt to homogenize consumer choice or override the preferences of those who value a more diverse set of automobile attributes than mpg and cost."[30]

Whether such additional information is really necessary, of course, is a matter of debate. Auto buyers already have access to a vast quantity of detailed information, provided by a seemingly endless supply of sources, regarding fuel economy and fuel savings in a vast number of websites, both private and public, including the EPA mileage stickers.

If automotive buyers, who see pump prices and fuel costs every time they fill up a tank of fuel, cannot be trusted to pursue their self-interest, who else can? But if that is the EPA's (and NHTSA's) conclusion, then the agencies should adopt the far less costly and more effective alternative of providing the information that it finds to be in inadequate supply.

[30] *Id*, pages 23 -25.

Defour/Alliance Rejoinder, Part 4g: Defour's Submission is Based on Up-to-Date Research

EPA claims that Defour and the Alliance rely on engineering cost estimates that are older than those used in its 2012 cost-benefit estimates (page A-28). This is simply not true. While we do rely on studies predating those estimates, we also cite very recent, up-to date estimates and reviews of those estimates.

We also referred to a recent literature review by Arthur van Bentham of the Wharton School of Finance at the University of Pennsylvania and Mathias Raynaert of France's Toulouse School of Economics, which summarizes the conclusions of mainstream economists:

"[M]ost studies conclude that [fuel economy] standards are so expensive that their cost to society exceeds the value of the carbon saved.[31]

This is not to mention the studies we cited in our February 2012 submissions that commented on EPA's benefit/cost analysis in support of the proposed standards.

Most importantly, and as we have emphasized in this submission, Gayer and Viscusi, in their July 2012 evaluation of the EPA's (and NHTSA's) benefit cost/analysis, took explicit account of the EPA's (and NHTSA's) estimate(s) of the engineering costs.[32] They nonetheless found that the costs, inclusive of "opportunity costs" (consumer welfare losses when they are denied the attributes they wish to get in a vehicle) vastly outweigh the benefits, even including the sum total of GHG emissions reductions and other societal (externality) costs.

Defour/Alliance Rejoinder, Part 4h: The EPA Benefit/Cost Analysis Violates OMB Guidelines

As we noted in our September 2012 submission, and as Gayer and Viscusi's analysis of the EPA's proposed 2017-2025 model year mandates concludes, there is a lack of systematic evidence to support the Greene/EPA/NHTSA assumptions of myopic consumer or manufacturer behavior. Gayer and Viscusi also note that this assumption violates OMB guidelines for conducting benefit/cost analysis.

"Taken as a whole, the engineering and empirical literature on the energy-efficiency gap does not provide strong, credible evidence of persistent consumer irrationality, and the literature on behavioral economics with respect to energy efficiency is still limited and unable to consistently demonstrate the magnitude of the contribution of behavioral deviations from rationality. BCAs should therefore operate under a presumption that consumers and producers accrue net gains from any private market transaction in which they voluntary engage.

"This presumption of the validity of revealed preference is explicitly recommended in the Office of Management and Budget's (OMB) guidelines for conducting regulatory analyses, known as Circular A-4. In considering the example in which emission standards lead to fuel savings, the OMB states, "These fuel savings will normally accrue to the engine purchasers, who also bear

[31] Arthur Van Benthem and Mathias Reynaert, "Can Fuel Economy Standards Save the Climate," *The Economist*, Jul 16th 2015.

[32] Gayer abd Viscusi,

the costs of the technologies. There is no apparent market failure with regard to the market value."[33]

Defour/Alliance Conclusion #3: The proposed standards will prove to be catastrophic for lower income and minority households. Contrary to popular opinion, fuel economy standards are much more costly and regressive than taxes on motor fuels, taxes which Congress has repeatedly rejected on grounds of excessive cost and regressivity.

EPA response: The EPA draws no conclusions regarding the relative cost of the two approaches. Rather, they argue that they are not required to investigate relative costs and that Greene and Welch tentatively conclude that standards are progressive.

Defour/Alliance Rejoinder: Each of the aforementioned mainstream economic studies demonstrates that whether based on footprint or on a flat standard for all vehicle sizes, the nation's fuel economy standards are much more costly and regressive than a fuel tax achieving the same level of reduction in greenhouse gases or increase in fuel savings. Jacobsen finds that the footprint-based standard is more costly than the flat-based standard. Levinson finds that the footprint standard is more regressive than the flat standard and both are more regressive than a fuel tax.

Levinson concludes:

"Either of the two policies under consideration—taxes or standards—make poor households worse off. But the burden of energy taxes falls relatively less on poor households than the burden of efficiency standards."[34]

EPA says that it must comply with the law and the law does not allow the option of a fuel or carbon tax in lieu of the fuel economy mandate. But, as Gayer and Viscusi note, "Even if the regulations must by law be issued, there could be changes to the analysis to show the true economic burdens of the regulations. <u>Indeed, OMB guidelines require that the agencies estimate the costs of not pursuing the optimal regulatory response due to legal constraints."</u>[35]

[33] *Id.,* page 14.

[34] Levinson, page 2.

[35] Gayer and Viscusi, page 38. Emphasis added.

Conclusion

EPA contends that the Defour/Alliance submission on September 21, 2016 fails to demonstrate that the EPA's proposed fuel economy standards are regressive, both absolutely and relative to a fuel tax achieving the same level of greenhouse gas emission reductions and fuel economy savings. But the findings of the Defour Group and the Alliance are also those of every mainstream, independent economic study – of every study that takes into account the full costs and benefits of fuel economy mandates for American workers and consumers and especially for those in low-income households. The proposed increase in the stringency of the nation's GHG emissions and fuel economy standards will have serious adverse consequences for low income families and individuals by reducing their access to low cost dependable mobility.

By confining its analysis to a comparison of upfront vehicle costs to the fuel savings generated by the proposed GHG reduction/fuel economy mandates, EPA instead finds enormous net benefits for automotive consumers and is unable to explain the so-called "energy efficiency paradox" – why auto buyers do not demand the fuel savings on their own and in their own self-interest. It attributes this supposed conundrum to a supposed inability of these consumers to make rational tradeoffs between the value of increased fuel savings in comparison to the increased vehicle costs necessary to achieve those savings. The EPA also does not consider that the economic trade-offs made by low income households may be substantially different from those of higher income households.

In so doing, EPA ignores the very substantial "opportunity" costs that binding standards impose on auto buyers when vehicle technology mandates deny low income households access to a myriad of vehicle amenities they require. Mainstream economic studies take account of those opportunity costs, finding instead enormous negative net benefits for the kinds of mandates proposed by the EPA.

The solution to the supposed "energy efficiency paradox" is that there really is no paradox at all. To quote Brookings Gayer and Vanderbilt's Viscusi: "The assumption that the world outside the agency is irrational is a direct consequence of the agencies' view that energy efficiency is always the paramount product attribute and that choices made on any other basis must be fundamentally flawed. . .. Overriding market decisions to advance the preferences of government agencies will always make consumers and firms worse off unless one demonstrates that there are fundamental flaws which, if recognized, would lead people to make decisions in line with the regulations."

The EPA fails to make that case. There is no systematic evidence that, taken as a whole, car buyers under-value fuel economy enhancements that can be generated by technological advances – certainly not to the degree that is assumed in the EPA's Benefit/Cost Analyses and in the work by its consultant, Greene, on which it so heavily relies.

To quote Gayer and Viscusi:

"Taken as a whole, the engineering and empirical literature on the energy-efficiency gap does not provide strong, credible evidence of persistent consumer irrationality, and the literature on behavioral economics with respect to energy efficiency is still limited and unable to consistently demonstrate the magnitude of the contribution of behavioral deviations from rationality. BCAs should therefore operate under a presumption that consumers and producers accrue net gains from any private market transaction in which they voluntary engage. This presumption of the validity of revealed preference is explicitly recommended in the Office of Management and Budget's (OMB) guidelines for conducting regulatory analyses, known as Circular A-4. In considering the example in which emission standards lead to fuel savings, the OMB states, "These fuel savings will normally accrue to the engine purchasers, who also bear the costs of the technologies. There is no apparent market failure with regard to the market value.'"[36]

It is for good reason that OMB's Circular A-4 guidelines for conducting regulatory analysis explicitly require the EPA . . . to assume rational consumer behavior in their benefit cost analyses of proposed regulations -- a requirement the agencies continue to skirt in their regulatory proceedings."

It is time for EPA to stop violating these OMB guidelines, as well as the findings of the vast weight of the economics literature.

If and when it incorporates the opportunity costs imposed by the standards as done in mainstream economic research, it will find that the proposed standards are justified neither by benefits to the nation's consumers nor by any societal or externality benefits and that the standards can have only a "negligible effect on greenhouse gases."[37] It will look for other, far less costly and more effective ways to achieve the nation's energy policy objectives.

[36] *Id.*, page 14. Emphasis added.

[37] Gayer and Viscussi.

Appendix: The "Energy Efficiency Paradox" and the Rational Consumer

The NHTSA and EPA Preliminary Regulatory Impact Analysis (PRIA) notes that their estimate of $4,000 per vehicle lifetime or net present value fuel savings for an "achievable" 47 mpg fuel economy level in MY 2025, when gasoline is expected to cost $3.54 per gallon, is inconsistent with the choices of today's vehicle buyers who are willing to pay for no more than 30 mpg for the combined fleet with gasoline prices ranging between $3 and $4 per gallon[38]. They surmise that this disparity, what they call an "energy paradox," can be explained by consumer myopia -- by auto buyers' irrational undervaluation of the present discounted value of future fuel savings. They ask for comments on this issue.

Our explanation of the agencies' quandary is quite simple. The inconsistency between what their engineering model predicts and what consumers actually want arises from the agencies' misspecification of their model, based on an erroneous definition of consumer rationality. According to the agencies' definition, rational consumers should be willing to purchase more "fuel-efficient" [they really mean more "fuel economical"] vehicles so long as the present value of the discounted additional energy savings associated with the requisite technologies equals or exceeds their hardware costs.

That is not how <u>rational</u> consumers behave. Improvements in fuel efficiency technology represent <u>either</u> the ability to reduce the amount of fuel required to move a given amount of mass (or achieve a given level of performance) <u>or</u> the ability to move more mass (or increase performance) for a given quantity of fuel consumed. Consumers can choose to spend the same technology on any number of attributes besides fuel economy and the (net present discounted) value of each of those other applications can <u>also</u> exceed the cost of the associated hardware in an engineering sense. Thus, the question is not whether the value exceeds the cost for any one application such as increased fuel economy, but rather, of all the applications, which gives consumers their highest value for the money – i.e., which is cost-effective in an <u>economic</u> sense? Indeed, at $3.54 per gallon, as the following analysis demonstrates and as Figure 1, page 3 of the text in the 2012 Defour submission confirms, spending fuel efficiency technology advances on fuel economy increases is likely to be near the bottom of their list.

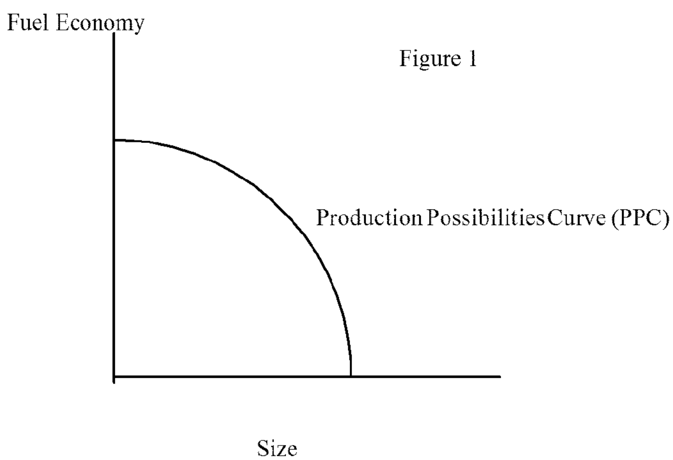
Indeed, because the current fuel economy standard is binding, it is very unlikely that increases in fuel economy can be achieved without substantially increasing the consumer and producer welfare (profit) losses associated with forcing consumers to spend the money on something they do not want.

The following figures illustrate the economic "postulates" that underlie consumer rationality. They provide the answer to the energy paradox, showing how fuel economy technologies can be "cost-effective" in a narrow engineering sense (with present discounted fuel savings equaling or exceeding the retail price equivalent for the increased hardware costs), yet irrational in an economic sense. We begin the discussion by first assuming that there are no restraints on consumer choice – no fuel economy or any other standards that limit what consumers can buy.

[38] All values in our 2012 submission were in 2009 dollars.

The economist's world is a world of tradeoffs, where at any point in time producing more of one thing, such as fuel economy cannot be achieved without producing less of something else, such as vehicle size. Figure 1 below assumes that there are two attributes of value to consumers, fuel economy and "size."[39] The curve labeled "production possibilities curve" or "PPC" illustrates a hypothetical set of maximum feasible combinations of these two attributes. For any point along the x axis – that is for any given quantity of vehicle size – this curve shows the maximum feasible level of fuel economy that could be achieved with that size of vehicle. Alternatively, for any point along the y axis – for any given level of fuel economy, it shows the "largest" possible vehicle that might be produced and sold.

Note that, consistent with practical reality, getting more fuel economy and moving in the northern direction, requires that vehicles be "smaller," a move in the western direction. Alternatively, a move in the eastward direction towards "larger" vehicles requires that fuel economy must decline.[40] Note, also, that the production possibilities curve is just another word for one level of fuel efficiency technology and that the technology can be applied to various combinations of fuel economy and size. Note, finally, this level of fuel efficiency is the level that is provided in a well-functioning, fully competitive market. Manufacturers that fail to provide this level simply are not able to survive amidst such competition.



[39] Of course, in the real world consumers value many other attributes, including performance (0 to 60 acceleration time), safety, comfort, towing capacity, and so on. In this two dimensional layout, we can think of size as a proxy for all those other vehicle attributes.

[40] Note that the economists' law of increasing marginal costs of production implies the concave shape of the production possibilities curve. In this context, this law implies that for each additional unit of fuel economy, the producer, and ultimately the consumer, must give up larger and larger amounts of size and vice versa.

Economists also view consumers as being willing to exchange one good for another in varying proportions, as illustrated in Figure 2 by a series of isoutility curves now superimposed on Figure 1.[41] Each isoutility curve represents a constant level of consumer satisfaction. The greater the northeasterly distance from the origin the greater is the constant level of utility, so that U_2 represents the highest and U_0 the lowest level of constant utility or satisfaction.[42]

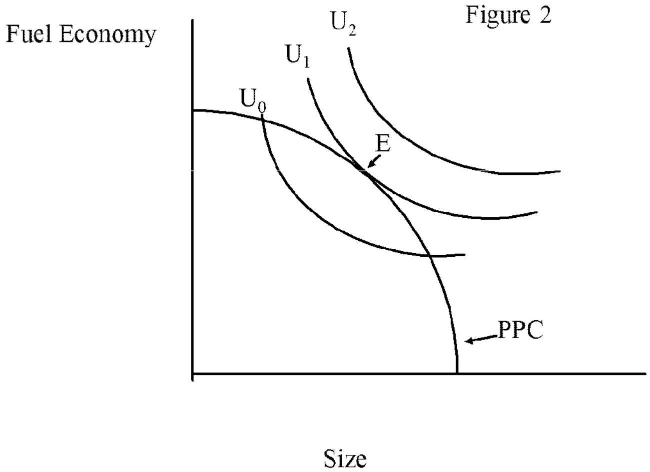


Figure 2

The consumers' optimum is reached where they can achieve the highest level of utility consistent with the feasible production set or production possibilities curve (PPC) as indicated by point E in Figure 2. This is the point where the additional utility or satisfaction obtained from spending a dollar on fuel economy just equals the additional utility derived from spending a dollar on size. Economists call this concept the "equal marginal principle" and it is a <u>fundamental</u> principle underlying their analysis of consumer and producer behavior. To quote MIT Professor Robert Pindyck and University of California Professor Daniel Rubinfeld:

"Only when the consumer has satisfied **the equal marginal principle** – i.e., *has equalized the marginal utility per dollar of expenditure across all goods* – will she have maximized utility."[43] (Boldface and italics in original.)

[41] For simplicity, we assume an aggregate consumer welfare function.

[42] The convex shape of each curve reflects the fact that consumers are willing to give up less and less "size" for increasing amounts of fuel economy and vice versa (what economists call diminishing marginal utility).

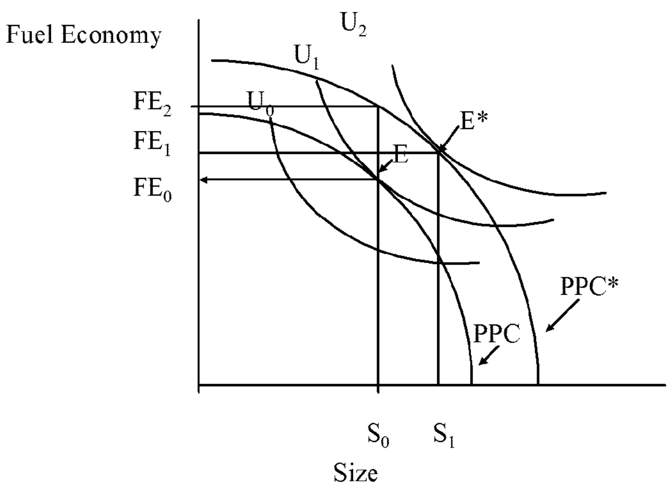
[43] Robert S. Pindyck and Daniel L. Rubinfeld, Microeconomics, (2001), p. 91.

Of course, this is the economists' operational definition of rationality, as contained in every basic text. In the present context, this principle requires that the added value or utility per each dollar spent be the same for all vehicle attributes.

Now suppose there is an outward shift in the production possibilities curve from PPC to PPC* – i.e., suppose there is an increase in the fuel efficiency technology applicable to cars and light trucks. Because consumers can spend improvements in fuel efficiency technology on either increased fuel economy or on size (a proxy for all other attributes of value), the production possibilities curve shifts outward in every direction.

Figure 3 shows the original hypothetical and unconstrained consumer equilibrium at point E, together with the new equilibrium at point E,* a point at which both fuel economy and "size" (again, a one-dimensional proxy for not just vehicle size, but also for performance, safety, and numerous other vehicle attributes that compete with fuel economy for the customers' limited budget) have increased as a result of the outward shift in the production possibilities curve. Note that in this hypothetical illustration the rightward or eastward increase in size from S_0 to S_1 is substantially greater than the upward or northward increase in fuel economy from FE_0 to FE_1. This is drawn this way because "size" is really a proxy for numerous other attributes besides fuel economy.

Figure 3



The answer to the agencies' "energy paradox" is that, contrary to their engineering model, rational, utility-maximizing and fully informed auto buyers will not be willing to spend all of the potential increase in fuel efficiency on increased fuel economy. This is so even though we are assuming that the net present value of the fuel economy savings from the new technology equals or exceeds the cost of the hardware (which has to be true for the new PPC to represent a maximum feasible set).

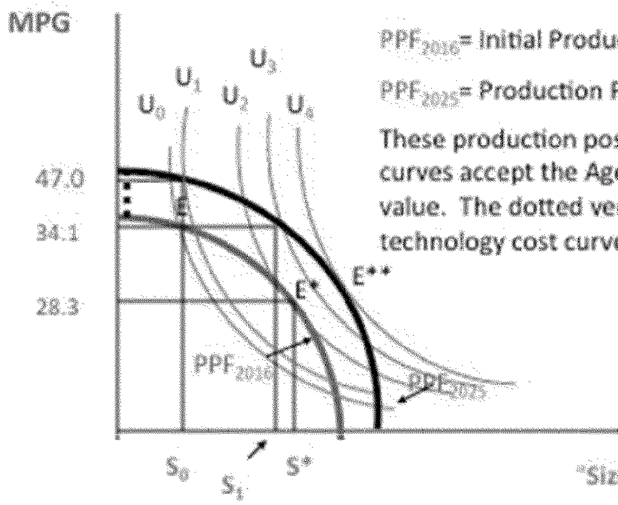
In other words, assume that the agencies' engineering analysis is correct and that FE_2 is the "achievable" level of fleet average fuel economy in MY 2025, or 47 miles per gallon. Assume further that, as in the agencies' engineering analysis, FE_0 is the baseline level of 34.1 mpg in MY 2016. The 12.9-mpg increase -- the vertical difference between FE_2 and FE_0 is the increase *if* consumers were willing to pay for 100% of the potential 12.9 mpg increase. It is "cost-effective" in the narrowly conceived engineering sense. But rational auto buyers are not willing to pay for 100% of the potential fuel economy increase. The 12.9-mpg increase in the fuel economy standard is *not* rational and cost-effective in an economic sense. That is because rational auto buyers will only be willing to pay for an increase to the unconstrained level, FE_1, a level that maximizes their utility (that puts them on the highest economically feasible isoutility curve), and which as shown in Figure 3 page 11 of the text of Defour's 2012 submission, the Energy Information Agency estimates to be just 35.3 mpg at $3.54 gasoline in MY 2025.

Finally, assume fuel efficiency technology advances as given by PPC_{2025} in Figure 4. Assume further that, initially, in MY 2016, consumers are free to choose the combination of fuel economy and other attributes of value and that 28.3 mpg is the free expression level. Thus, E* (28.3 mpg, S* size) on isoutility curve U_2 is the current optimum, or the point that satisfies the "equal marginal principle" for rational consumers.

Assume next that they are forced to purchase the MY 2016 mandate of 34.1 mpg, which puts them at Point E where "Size" is S_0 and their utility has been reduced to U_0.

In 2025, these still-constrained consumers would maximize their utility or satisfaction at point E,** which would entail an actual reduction in mpg to a level below the 34.1 mpg mandate in 2016. In other words, constrained consumers will be willing to pay to *reduce* fuel economy or mpg to just above the MY 2016 level of 28.3. Forcing them to take any of the mandated increase in fuel efficiency technology for MY 2025 as fuel economy will impose a loss of consumer welfare -- will force them onto a lower utility curve, or U_1, where they must take all of the technology advance in the form of fuel economy. This conclusion holds regardless of whether one accepts any or all of the proposed technologies on the dotted vertical line as cost-effective in an engineering sense.

Figure 4: Constrained Consumers Will Not Purchase More Fuel Economy



PPF_{2016}= Initial Production Possibility Frontier

PPF_{2025}= Production Possibility Frontier for 2025

These production possibility or fuel efficiency technology curves accept the Agencies' engineering estimates at face value. The dotted vertical line represents the Agencies' technology cost curve: each dot is one of their technologies.

"Size" (All other vehicle attributes)

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Cc: Moran, Robin[moran.robin@epa.gov]
To: Bolon, Kevin[Bolon.Kevin@epa.gov]
From: John German
Sent: Mon 9/19/2016 10:39:34 PM
Subject: Re: 9/22 Hearing

Much appreciated, Kevin. This has been a huge help.
John

On Sep 19, 2016, at 6:15 PM, Bolon, Kevin <Bolon.Kevin@epa.gov> wrote:

See my definitions in red below.
-Kevin

From: John German [mailto:john@theicct.org]
Sent: Monday, September 19, 2016 2:54 PM
To: Bolon, Kevin <Bolon.Kevin@epa.gov>
Cc: Moran, Robin <moran.robin@epa.gov>
Subject: Re: 9/22 Hearing

Following is the list of acronyms that I don't understand:
ASL1 – Aggressive shift logic, level 1 (for the TAR, this is assumed to incorporated in the baseline fleet TRX11 and above)
ASL2 – Aggressive shift logic, level 2 (for the TAR, this is assumed to incorporated in the baseline fleet TRX11 and above)
EFR1 – Engine friction reduction, level 1
EFR2 – Engine friction reduction, level 2
HEG (although its zero) – High Efficiency Gearbox (HEG1 is assumed for TRX11 and TRX21, HEG2 is assumed for TRX12 and TRX22)
IACC1 – Improved Accessories, level 1
IACC2 – Improved Accessories, level 2
LDB – Low drag brakes
LRRT1 – Low rolling resistance tires, level 1
LRRT2 – Low rolling resistance tires, level 2
LUB – Low friction lubricants
REEV - I assume this is range-extended PHEV. However, I didn't see anything for regular PHEVs. – Range extended electric vehicle, synonymous with PHEV
SAX – Secondary axle disconnect for 4WD/AWD vehicles
SAX-NA – Indicator that SAX is not applicable in the case of FWD/RWD vehicles
TORQ (although its zero) Early torque converter lockup (for the TAR, this is assumed to incorporated in the baseline fleet TRX11 and above)
TRX11 – current gen 6spd ATs, CVTs
TRX12 – improved efficiency 6spd ATs
TRX21 – current gen wide ratio spread (i.e. 7+spd ATs), improved efficiency CVTs
TRX22 – improved efficiency wide ratio spread (i.e. 7+spd ATs) Also, while I know the various TRX refer to transmissions, do they distinguish between DCT and conventional automatic?

WRnet – net mass reduction, accounting for mass reduction penalty (WRnet = WRtech – WRpen), relative to 0% MR of null tech package (note that baseline vehicles may have some MR already applied)
WRpen – mass reduction penalty (additional mass for electrified powertrain: battery, motor etc.)
WRtech – mass reduction technology level applied, relative to 0% MR of null tech package

On Sep 19, 2016, at 2:01 PM, Bolon, Kevin <Bolon.Kevin@epa.gov> wrote:

Full hybrids in our analysis do use an Atkinson cycle, but a low compression ratio type such as the one used in the current Prius (thus the distinction between ATK1 for low CR, and ATK2 for high CR). The summary I provided does include MHEVs in the tech pens for IC engine technologies, but since ATK1 is not shown, HEVs are not included in tech pens for IC engines technologies (although the more detailed breakdown of tech pens that I attached in that earlier Excel file does show ATK1 tech pens).

Acronyms were defined as they were discussed in the text of the TAR, but there is no consolidated list of technology acronyms. For the most part, they should be self-explanatory, but obviously there are cases (like above) where it's not. If you have a few specific acronym that you would like some further explanation, please let me know.

-Kevin

From: John German [mailto:john@theicct.org]
Sent: Monday, September 19, 2016 1:30 PM
To: Bolon, Kevin <Bolon.Kevin@epa.gov>
Cc: Moran, Robin <moran.robin@epa.gov>
Subject: Re: 9/22 Hearing

Thanks, Kevin. Answer on Miler cycle makes sense - but less so on the balance of vehicles. Full and mild HEVs are still primarily dependent on ICE for propulsion. Your summary should include the engines used in hybrid applications.

Also, could you point me towards a list of definitions for all the of acronyms in your 4 worksheets?

John

On Sep 19, 2016, at 12:28 PM, Bolon, Kevin <Bolon.Kevin@epa.gov> wrote:

About 8% of the balance of vehicles have strong electrification (3%HEV, 2%PHEV, 3%EV). The remaining 10% or so of vehicles have some mild hybridization, although I don't have the exact proportion readily available since that MHEV technology is also present on some of the ATK2 and TDS vehicles. Between ATK2, TDS, MHEV, PHEV, and EV, it's going to be close to or equal to 100% of the fleet.

You had another question about the 4% penetration of Miller cycle, and why it was so low. The short answer is that, unlike TDS24, there is no engine downsizing assumed with the addition of Miller cycle. So although there is a substantial effectiveness benefit, the costs are higher than TDS24 because there's no potential to drop cylinders from I4→I3/V6→I4/V6→V8.

I hope that helps,
Kevin

From: John German [mailto:john@theicct.org]
Sent: Saturday, September 17, 2016 5:32 PM
To: Bolon, Kevin <Bolon.Kevin@epa.gov>
Cc: Moran, Robin <moran.robin@epa.gov>
Subject: Re: 9/22 Hearing

Sorry, I do have another question.

When I add up the various turbo and Atkinson percentages, I don't get anywhere close to 100%, i.e. 37% turbo, 44% Atkinson, or 81% total. What are the rest?

John

On Sep 16, 2016, at 7:10 PM, John German <john@theicct.org> wrote:

Hopefully I will have no more questions, Kevin. Thanks again for all your help.

John

On Sep 16, 2016, at 6:01 PM, Bolon, Kevin <Bolon.Kevin@epa.gov> wrote:

We didn't apply any additional restrictions to Miller cycle, beyond the relatively high (75%) penetration caps that are applied to TDS24, so your question about the relatively low penetration is a good one. My initial thought is that, like mass reduction penetrations, it really just illustrates how manufacturers have a number of cost effective options for compliance, but let me do a little more investigating to see if there were any other factors.

Ex. 6 - Personal Privacy

-Kevin

From: John German [mailto:john@theicct.org]
Sent: Friday, September 16, 2016 4:17 PM
To: Bolon, Kevin <Bolon.Kevin@epa.gov>
Cc: Moran, Robin <moran.robin@epa.gov>
Subject: Re: 9/22 Hearing

Exactly. :)

You only applied Miller cycle to 4% of the 2025 fleet? Why so conservative? The first applications are already in production and the turbo suppliers tell us that everyone is headed this way.

John

On Sep 16, 2016, at 3:56 PM, Bolon, Kevin <Bolon.Kevin@epa.gov> wrote:

We did include Miller cycle, which is represented in the tech pen table that I provided as 'TURBM'. We referenced the engine map published by VW on their 2016 2.0L EA888 engine in the TAR, and technology was applied to 4% of the 2025 fleet in our OMEGA analysis.

We also included variable geometry turbo; our estimates for TDS24 cost and effectiveness are based on the assumption that this technology is employed.

We did not explicitly model e-boost, VCR, or dynamic cylinder deactivation. Nor did we model HCCI, water injected turbos, or 48V MHEVs with a P2 configuration, although we do discuss the state of all of these technologies in the TAR write up. I think that remember hearing you mention before that EPA's analyses tend to be inherently conservative because we model only those technologies that we have a high degree of certainty in. It's obviously critical that we have a robust, defensible analysis, while at the same time, in response to criticism that we are overly optimistic, it seems fair for you to note in your testimony that we have not included these potentially promising future technologies, and of course there may be other technology innovations that are unforeseen.

- Kevin

From: John German [mailto:john@theicct.org]

Sent: Friday, September 16, 2016 2:42 PM
To: Bolon, Kevin <Bolon.Kevin@epa.gov>
Cc: Moran, Robin <moran.robin@epa.gov>
Subject: Re: 9/22 Hearing

Thanks, Kevin.

What about some of the technologies that are just now starting to enter production? Specifically, did the TAR include or evaluate any of the following technologies:

- Miller cycle (for turbos)
- E-boost (48v)
- Variable Compression Ratio
- VGT (variable geometry turbo) for gasoline engines
- Dynamic cylinder deactivation (i.e. deactivating individual cylinders every other stroke)

John

On Sep 16, 2016, at 10:46 AM, Bolon, Kevin <Bolon.Kevin@epa.gov> wrote:

Yes, there were multiple updates to cost and efficiency.

Focusing on EPA's analysis here, in addition to the newly added and very important ATK2 and 48V MHEV technologies mentioned below, here are some of the other highlights:
- Updated mass reduction costs, based on 4 independent teardown studies (Venza, Accord, 2011 and 2014 Silverado's), which at lower levels of mass reduction produced lower costs than the FRM estimates. Some of these cost savings were not available in our analysis with an updated baseline fleet, which we estimated had on average 2%MR relative to our 0% point on the cost curve.
- Increased effectiveness of future 8-speed transmissions (referred to as TRX22 in the TAR), as informed by benchmarking of multiple transmissions, published reports of future planned improvements by ZF, and results from our physics-based Alpha model.
- A significant reduction in battery cost estimates for the TAR for EVs and PHEVs as a result of updated battery and motor sizing estimates, and the application of DOE's latest version of the BatPaC model.
- Improved on-cycle effectiveness estimates for stop-start, based on more recent implementations of the technology

Not all of the changes from the FRM were in the direction of

lower costs and higher effectiveness. Specifically:
- lowered effectiveness estimate for cylinder deactivation, based on our benchmarking of the Silverado V6 Ecotec engine
- costs for TDS24 are higher due to the additional costs of a variable geometry turbocharger with was not accounted for in the FRM.

I may have left out a few of the differences from the FRM, but those are the main ones. And for all the technologies, costs have been updated using 2013$, and an updated learning rate.

You asked a question in your other email about why we saw lower MR rates in the TAR than the FRM. First, I would point out that they are only slightly lower (6% vs 7%). But it's still a reasonable question, especially given our updated cost curves. I think there are a few factors at play here. First, that's the fleet average. There are specific vehicles, trucks especially, that have higher levels applied. Second, the fact that more MR wasn't applied really speaks to the range of other technologies that manufacturers have available for a cost-effective compliance pathway. In all of our sensitivity analyses, the consistent theme was that our results were not dependent on any one single technology. Restricting the application of a single technology (e.g. ATK2, or even MR) resulted in an increase in the penetration of other technologies, but did not really have a major impact on the $/vehicle compliance costs. That might be a point that's worth mentioning in your testimony: The MY2022-2025 standards are not dependent on any single technology; There are multiple promising technology pathways, and there are already several examples where different strategies employed by manufactures have produced competition in innovation (AT vs CVT, TDS vs ATK2, HSS vs Aluminum, etc.)

-Kevin

From: John German [mailto:john@theicct.org]
Sent: Thursday, September 15, 2016 5:35 PM
To: Bolon, Kevin <Bolon.Kevin@epa.gov>
Cc: Moran, Robin <moran.robin@epa.gov>
Subject: Re: 9/22 Hearing

Thanks, Kevin. Very helpful.

Were there any significant changes to the cost or efficiency improvement estimates from the rulemaking to the TAR?

John

On Sep 15, 2016, at 5:18 PM, Bolon, Kevin <Bolon.Kevin@epa.gov> wrote:

Hi John,

As Robin, mentioned, we didn't include a side-by-side comparison of tech pens in the TAR, but it was relatively easy for me to pull together from the FRM and TAR text, and materials posted to the docket. The table below (also in the attached file) shows tech pens for EPA's MY2025 control case analyses. The trends are as one would expect; highly cost-effective technologies like low rolling resistance tires, advanced transmissions, improved accessories, and engine friction reduction all have very high penetration rates in both the FRM and TAR. Aero2 and electric power steering were also almost universally applied in the TAR, but aren't shown here because those numbers weren't presented in the FRM (I'm sure that the FRM did have high penetration of those techs).

<image003.png>

The most significant change in the TAR tech penetrations was due to the addition of the cost-effective ATK2 technology (i.e. high compression Atkinson engines, like Mazda's SkyActiv), which resulted in a reduction in the penetrations of turbo downsizing and hybridization. We also implemented a more cost effective Mild Hybrid, based on a 48V system, but since there are a variety of other cost-effective technologies available, penetration was less than 20% of the fleet in the TAR.

I have not included NHTSA's tech penetrations, which show much lower penetrations of high compression Atkinson engines due to restrictions in the CAFE analysis that limit application of the technology to three manufacturers.

I'll be available tomorrow afternoon, so please feel free to call or email with any follow-up questions you have. Good luck with your testimony!

-Kevin

Kevin Bolon, Ph.D.
Light Duty Center, Assessment and Standards Division
National Vehicle and Fuel Emissions Laboratory
U.S. EPA, Office of Transportation and Air Quality
734-214-4331 bolon.kevin@epa.gov

From: John German [mailto:john@theicct.org]
Sent: Thursday, September 15, 2016 3:34 PM
To: Moran, Robin <moran.robin@epa.gov>
Cc: Bolon, Kevin <Bolon.Kevin@epa.gov>
Subject: Re: 9/22 Hearing

Thanks, Kevin.

I won't have a chance to start working on my testimony until tomorrow, so if I could get this by about 2:00 pm tomorrow (Friday), that would be great.

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On Sep 15, 2016, at 3:11 PM, Moran, Robin <moran.robin@epa.gov> wrote:

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Would also be great if you mentioned the rigorous peer-reviewed state-of-the-art cost studies we've done to support rules, including pointing to the NAS's endorsement of such approaches as the most appropriate way to get at costs. This to counter what we may see from others as "surveys" of automakers purporting higher costs.

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Glad you got away in August!

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(b) assuming technology innovation stops today. Technology is developing so fast that either of these will yield higher cost estimates, not because there is anything wrong with the methods, simply because the latest developments are not included. I might use the best-in-class analysis done by Novation Analytics as an example - for example, their report stated, ""Novation's approach means that the best-in-class technology today would be the average performance of that same technology in 2025." They present this as though current best-in-class technology is the best we can do by 2025. The reality is that the average vehicle in 2025 will be much more efficient that best-in-class technology today.

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Hi John,

I hear you have the honor of being a testifier at the Congressional hearing on the midterm review next week. Could you let me know what your key messages will be, or even maybe share a draft testimony? I'm helping with all the prep for Janet's testimony.

Sorry I didn't have a chance to say hi when you were here for Bob's retirement party this week (I saw you from across the room). That was really nice that you came by. It was a nice send-off for Bob!

Take care,
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Robin Moran
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(734) 214-4821 (fax)

<EPA tech penetrations - FRM vs TAR_20160915.xlsx>

Cc: Moran, Robin[moran.robin@epa.gov]
To: Bolon, Kevin[Bolon.Kevin@epa.gov]
From: John German
Sent: Mon 9/19/2016 10:38:13 PM
Subject: Re: 9/22 Hearing

Very clear. I would have preferred to see separate penetration estimates, but at least I understand what was done.
BTW, there is a "CVT" column in the "TAR TechPen_Control_in2025" worksheet, which says 0%.

John

On Sep 19, 2016, at 5:57 PM, Bolon, Kevin <Bolon.Kevin@epa.gov> wrote:

Because the fundamental mechanisms for improving transmissions are not specific to the particular architecture (broader ratio spreads, improved matching between load and engine operation point, improved transmission efficiency) for the TAR we defined effectiveness improvements by generic transmission categories: TRX11 is used to characterize CVTs and 6spd ATs, and associated improvements over current 4 and 5 speed transmissions. TRX21 is used to characterize wider ratios of 7+ speed AT transmissions available today. Future transmission efficiency gains in CVTs are represented by the incremental improvements from TRX11 to TRX21.

To answer your question directly, yes, we did reassess CVT's for the TAR based on data from actual CVT implementations and ALPHA modeling that accounted for CVT-specific losses, and ratio change strategy. Based on that assessment, we estimated effectiveness improvement to go from a current 4 speed (i.e. null tech package) to a current CVT to be about 7%, which is the same improvement we assumed to go from a 4 speed to a 6 speed AT. For future CVT transmissions, we assumed it would provide 13% emissions reduction form the current 4 speed, which is the same improved assumed for a current 7+ speed AT related to a 4 speed. The penetration of TRX21 in our analysis in MY2025 was 51.5%, but we did not attempt to draw a distinction between how much of that 51.5% was improved CVT's, and how much was 7+ speed ATs.

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Ex. 6 - Personal Privacy

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- Miller cycle (for turbos)
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- Variable Compression Ratio
- VGT (variable geometry turbo) for gasoline engines
- Dynamic cylinder deactivation (i.e. deactivating individual cylinders every other stroke)

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Yes, there were multiple updates to cost and efficiency.

Focusing on EPA's analysis here, in addition to the newly added and very important ATK2 and 48V MHEV technologies mentioned below, here are some of the other highlights:
- Updated mass reduction costs, based on 4 independent teardown studies (Venza, Accord, 2011 and 2014 Silverado's), which at lower levels of mass reduction produced lower costs than the FRM estimates. Some of these cost savings were not available in our analysis with an updated baseline fleet, which we estimated had on average 2%MR relative to our 0% point on the cost curve.
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Not all of the changes from the FRM were in the direction of lower costs and higher effectiveness. Specifically:
- lowered effectiveness estimate for cylinder deactivation, based on our benchmarking of the Silverado V6 Ecotec engine
- costs for TDS24 are higher due to the additional costs of a variable geometry turbocharger with was not accounted for in the FRM.

I may have left out a few of the differences from the FRM, but those are the main ones. And for all the technologies, costs have been updated using 2013$, and an updated learning rate.

You asked a question in your other email about why we saw lower MR rates in the TAR than the FRM. First, I would point out that they are only slightly lower (6% vs 7%). But it's still a reasonable question, especially given our updated cost curves. I think there are a few factors at play here. First, that's the fleet average. There are specific vehicles, trucks especially, that have higher levels applied. Second, the fact that more MR wasn't applied really speaks to the range of other technologies that manufacturers have available for a cost-effective compliance pathway. In all of our sensitivity analyses, the consistent theme was that our results were not dependent on any one single technology. Restricting the application of a single technology (e.g. ATK2, or even MR) resulted in an increase in the penetration of other technologies, but did not really have a major impact on the $/vehicle compliance costs. That might be a point that's worth mentioning in your testimony: The MY2022-2025 standards are not dependent on any single technology; There are multiple promising technology pathways, and there are already several examples where different strategies employed by manufactures have produced competition in innovation (AT vs CVT, TDS vs ATK2, HSS vs Aluminum, etc.)

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Thanks, Kevin. Very helpful.

Were there any significant changes to the cost or efficiency improvement estimates from the rulemaking to the TAR?

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On Sep 15, 2016, at 5:18 PM, Bolon, Kevin <Bolon.Kevin@epa.gov> wrote:

Hi John,

As Robin, mentioned, we didn't include a side-by-side comparison of tech pens in the TAR, but it was relatively easy for me to pull together from the FRM and TAR text, and materials posted to the docket. The table below (also in the attached file) shows tech pens for EPA's MY2025 control case analyses. The trends are as one would expect; highly cost-effective technologies like low rolling resistance tires, advanced transmissions, improved accessories, and engine friction reduction all have very high penetration rates in both the FRM and TAR. Aero2 and electric power steering were also almost universally applied in the TAR, but aren't shown here because those numbers weren't presented in the FRM (I'm sure that the FRM did have high penetration of those techs).

<image003.png>

The most significant change in the TAR tech penetrations was due to the addition of the cost-effective ATK2 technology (i.e. high compression Atkinson engines, like Mazda's SkyActiv), which resulted in a reduction in the penetrations of turbo downsizing and hybridization. We also implemented a more cost effective Mild Hybrid, based on a 48V system, but since there are a variety of other cost-effective technologies available, penetration was less than 20% of the fleet in the TAR.

I have not included NHTSA's tech penetrations, which show much lower penetrations of high compression Atkinson engines due to restrictions in the CAFE analysis that limit application of the technology to three manufacturers.

I'll be available tomorrow afternoon, so please feel free to call or email with any follow-up questions you have. Good luck with your testimony!

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To: Bolon, Kevin[Bolon.Kevin@epa.gov]
From: John German
Sent: Mon 9/19/2016 6:54:07 PM
Subject: Re: 9/22 Hearing

Following is the list of acronyms that I don't understand:
ASL1
ASL2
EFR1
EFR2
HEG (although its zero)
IACC1
IACC2
LDB
LRRT1
LRRT2
LUB
REEV - I assume this is range-extended PHEV. However, I didn't see anything for regular PHEVs.
SAX
SAX-NA
TORQ (although its zero)
TRX11
TRX12
TRX21
TRX22 - Also, while I know the various TRX refer to transmissions, do they distinguish between DCT and conventional automatic?
WRnet
WRpen
WRtech

On Sep 19, 2016, at 2:01 PM, Bolon, Kevin <Bolon.Kevin@epa.gov> wrote:

Full hybrids in our analysis do use an Atkinson cycle, but a low compression ratio type such as the one used in the current Prius (thus the distinction between ATK1 for low CR, and ATK2 for high CR). The summary I provided does include MHEVs in the tech pens for IC engine technologies, but since ATK1 is not shown, HEVs are not included in tech pens for IC engines technologies (although the more detailed breakdown of tech pens that I attached in that earlier Excel file does show ATK1 tech pens).

Acronyms were defined as they were discussed in the text of the TAR, but there is no consolidated list of technology acronyms. For the most part, they should be self-explanatory, but obviously there are cases (like above) where it's not. If you have a

few specific acronym that you would like some further explanation, please let me know.

-Kevin

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Subject: Re: 9/22 Hearing

Thanks, Kevin. Answer on Miler cycle makes sense - but less so on the balance of vehicles. Full and mild HEVs are still primarily dependent on ICE for propulsion. Your summary should include the engines used in hybrid applications.

Also, could you point me towards a list of definitions for all the of acronyms in your 4 worksheets?

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You had another question about the 4% penetration of Miller cycle, and why it was so low. The short answer is that, unlike TDS24, there is no engine downsizing assumed with the addition of Miller cycle. So although there is a substantial effectiveness benefit, the costs are higher than TDS24 because there's no potential to drop cylinders from I4→I3/V6→I4/V6→V8.

I hope that helps,
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Sorry, I do have another question.

When I add up the various turbo and Atkinson percentages, I don't get anywhere close to 100%, i.e. 37% turbo, 44% Atkinson, or 81% total. What are the rest?

John

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I'm headed home for the day, but if you send along any other questions over the weekend, I should be able to respond on Monday.

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Exactly. :)

You only applied Miller cycle to 4% of the 2025 fleet? Why so conservative? The first applications are already in production and the turbo suppliers tell us that everyone is headed this way.

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I may have left out a few of the differences from the FRM, but those are the main ones. And for all the technologies, costs have been updated using 2013$, and an updated learning rate.

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Cc: Moran, Robin <moran.robin@epa.gov>
Subject: Re: 9/22 Hearing

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I have not included NHTSA's tech penetrations, which show much lower penetrations of high compression Atkinson engines due to restrictions in the CAFE analysis that limit application of the technology to three manufacturers.

I'll be available tomorrow afternoon, so please feel free to call or email with any follow-up questions you have. Good luck with your testimony!

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The reality is that the average vehicle in 2025 will be much more efficient that best-in-class technology today.

I will also discuss consumer issues. Two main points. First, there isn't a consumer backlash if the fuel savings more than pay for the increase in the monthly car payment. Second, and more important, most of these technologies have other attributes that are desired by consumers, so much of the explosion in 7+ speed transmissions, GDI, turbocharging, and lightweighting is because consumers want the performance provided by these technologies.

I might touch on safety - haven't decided yet.

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Hi John,

I hear you have the honor of being a testifier at the Congressional hearing on the midterm review next week. Could you let me know what your key messages will be, or even maybe share a draft testimony? I'm helping with all the prep for Janet's testimony.

Ex. 6 - Personal Privacy

Take care,
Robin

Robin Moran

Senior Policy Advisor
U.S. EPA, Office of Transportation and Air Quality
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Ann Arbor, MI 48105
(734) 214-4781 (phone)
(734) 214-4821 (fax)

<EPA tech penetrations - FRM vs TAR_20160915.xlsx>

To: Moran, Robin[moran.robin@epa.gov]; Bolon, Kevin[Bolon.Kevin@epa.gov]
From: John German
Sent: Mon 9/19/2016 2:56:52 PM
Subject: Fwd: 9/22 Hearing
J German Testimony for House TAR hearing v1.docx
ATT00001.htm

Robin/Kevin,
Attached is the first draft of my written testimony. I must submit this by 10:00 am Tuesday, so this doesn't give people much time to review. I need **all comments by 6:00 EDT tomorrow (Monday)**, so that I get a chance to revise before having to submit. I should be able to read through the Indiana Univ. report (John Graham) tomorrow, and I might add something to my written testimony to specifically rebut findings in that study. I will also try to get through the Ricardo Calstart report that Nic sent me on Friday, which I did not have a chance to review yet. I will be available most of the day tomorrow if you want to discuss aspects. Also, feel free to forward to anyone you think might be interested.

After I submit the written testimony, I will turn my attention to writing my oral statement and preparing for questions for the committee. Any help and suggests for preparing for questions would also be appreciated, although these can be on Tuesday or Wednesday. I am flying to DC Wednesday morning and I will be at the ICCT office Wed. afternoon, if anyone wants to do any prep in person.

John

Cc: Moran, Robin[moran.robin@epa.gov]
To: Bolon, Kevin[Bolon.Kevin@epa.gov]
From: John German
Sent: Sat 9/17/2016 9:32:09 PM
Subject: Re: 9/22 Hearing

Sorry, I do have another question.
When I add up the various turbo and Atkinson percentages, I don't get anywhere close to 100%, i.e. 37% turbo, 44% Atkinson, or 81% total. What are the rest?

John

On Sep 16, 2016, at 7:10 PM, John German <john@theicct.org> wrote:

Hopefully I will have no more questions, Kevin. Thanks again for all your help.
John

On Sep 16, 2016, at 6:01 PM, Bolon, Kevin <Bolon.Kevin@epa.gov> wrote:

We didn't apply any additional restrictions to Miller cycle, beyond the relatively high (75%) penetration caps that are applied to TDS24, so your question about the relatively low penetration is a good one. My initial thought is that, like mass reduction penetrations, it really just illustrates how manufacturers have a number of cost effective options for compliance, but let me do a little more investigating to see if there were any other factors.

Ex. 6 - Personal Privacy

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Exactly. :)

You only applied Miller cycle to 4% of the 2025 fleet? Why so conservative? The first applications are already in production and the turbo suppliers tell us that everyone is headed this way.

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On Sep 16, 2016, at 3:56 PM, Bolon, Kevin <Bolon.Kevin@epa.gov>

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We also included variable geometry turbo; our estimates for TDS24 cost and effectiveness are based on the assumption that this technology is employed.

We did not explicitly model e-boost, VCR, or dynamic cylinder deactivation. Nor did we model HCCI, water injected turbos, or 48V MHEVs with a P2 configuration, although we do discuss the state of all of these technologies in the TAR write up. I think that remember hearing you mention before that EPA's analyses tend to be inherently conservative because we model only those technologies that we have a high degree of certainty in. It's obviously critical that we have a robust, defensible analysis, while at the same time, in response to criticism that we are overly optimistic, it seems fair for you to note in your testimony that we have not included these potentially promising future technologies, and of course there may be other technology innovations that are unforeseen.

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What about some of the technologies that are just now starting to enter production? Specifically, did the TAR include or evaluate any of the following technologies:

- Miller cycle (for turbos)
- E-boost (48v)
- Variable Compression Ratio
- VGT (variable geometry turbo) for gasoline engines
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734-214-4331 bolon.kevin@epa.gov

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From: Mader, Pippin@ARB
Sent: Tue 8/9/2016 8:24:39 PM
Subject: Summary of Todays Omega/Symposium meeting

Action items from todays meeting:

- ARB to look into providing MY2015 Novation fleet to EPA for MY2015 baseline
- Kevin to provide Dana contact
- ARB to send invite for HEV/PHEV power electronics meetings

Topics discussed for symposium:

IC engine technology:

- Tula Skipfire (now licensed to GM)
- Variable compression ratio – Nissan/FEV

Transmissions:

- Dana, variglide

Mass reduction:

- Carbon fiber, fraun Hofer institute, they were a partner with BMW on I3
- Monroe, teardown of I3
- Interior light weighting

P2-48 volt (vs current 48 volt BASG system)

- Schaeffler

- Continental
- Borg Warner (e-turbo)

Pippin Mader, P.E.

California Air Resources Board

Desk: 916-445-8113

Cell: 530-400-6047

Begin forwarded message:

From: John German <john@theicct.org>
Subject: Re: 9/22 Hearing
Date: September 17, 2016 at 5:32:09 PM EDT
To: "Bolon, Kevin" <Bolon.Kevin@epa.gov>
Cc: "Moran, Robin" <moran.robin@epa.gov>

Sorry, I do have another question.
When I add up the various turbo and Atkinson percentages, I don't get anywhere close to 100%, i.e. 37% turbo, 44% Atkinson, or 81% total. What are the rest?

John

> On Sep 16, 2016, at 7:10 PM, John German <john@theicct.org> wrote:
>
> Hopefully I will have no more questions, Kevin. Thanks again for all your help.
> John
>
>> On Sep 16, 2016, at 6:01 PM, Bolon, Kevin <Bolon.Kevin@epa.gov> wrote:
>>
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>>
>> **Ex. 6 - Personal Privacy**
>>
>> **-Kevin**
>>
>> **From:** John German [mailto:john@theicct.org]
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preparing for this testimony will most of the free time I have left.

John

On Sep 14, 2016, at 2:28 PM, Moran, Robin <moran.robin@epa.gov> wrote:

Hi John,

I hear you have the honor of being a testifier at the Congressional hearing on the midterm review next week. Could you let me know what your key messages will be, or even maybe share a draft testimony? I'm helping with all the prep for Janet's testimony.

Ex. 6 - Personal Privacy

Ex. 6 - Personal Privacy

Take care,
Robin

Robin Moran
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<EPA tech penetrations - FRM vs TAR_20160915.xlsx>

Statement of John German
Senior Fellow
International Council on Clean Transportation (ICCT)

Before the

Subcommittee on Commerce, Manufacturing, and Trade and the Subcommittee on Energy and Power

Committee on Energy and Commerce

U.S. House of Representatives

On

Midterm Review and an Update on the Corporate Average Fuel Economy Program and Greenhouse Gas Emissions Standards for Motor Vehicles

September 22, 2016

Mr. Chairman, good morning. My name is John German, Senior Fellow and Program Director for the International Council on Clean Transportation (ICCT), with primarily responsibility for technology innovation and U.S. policy development. I have been actively involved with vehicle technology and efficiency for 40 years. In earlier stages of my career, I spent 8 years in Powertrain Engineering at Chrysler working on fuel economy issues, followed by 13 years doing research and writing regulations for EPA's Office of Mobile Sources and 11 years as Manager of Environmental and Energy Analyses for American Honda Motor Company. To support my credentials, I was the first recipient of the Barry D. McNutt award, presented annually by SAE for Excellence in Automotive Policy Analysis. Thank you for the opportunity to appear before the House Subcommittees on Commerce, Manufacturing, and Trade and Energy and Power to present our views on vehicles and technology and how they relate to the mid-term review of the CAFE and greenhouse gas standards.

TECHNOLOGY

During the course of my 40-year career, initial cost estimates for complying with emissions and efficiency requirements have consistently been overstated. Not some of the time, or even most of the time, but all of the time. While he said it in an entirely different context, Donald Rumsfeld hit the nail on the head:

> "there are known knowns; there are things that we know that we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns, the ones we don't know we don't know."

To relate this specifically to projections of vehicle efficiency and cost, studies and reports usually do a good job laying out the things that we know, i.e. the technologies that are already in use. While most reports stop here, the better reports also attempt to lay out the known unknows, such as technology that is already in development somewhere and estimates of cost reductions due to learning and volume. But unknown unknowns, i.e. technology innovations, are almost never assessed, even though there is a long history of constant technology innovation. There is a good reason for this – they are unknown. What this means is that **the single most important factor in the accuracy of cost and benefit projections is the use of the latest, most up to date technology data and developments.** Using older data guarantees that the cost of meeting the standard will be overstated, as it does not include more recent technology developments and thus must default to more expensive technology, such as full hybrids. Similarly, assuming that the end of innovation has been reached and basing projections on what is in production today ignores technology developments in process and overstates the cost of future compliance.

Contrary to the common perception that the internal combustion engine at the end of its development, the pace of technology innovation is accelerating. This is because there has been a genuine technology revolution - computers. Computer simulations and computer-aided-design are enabling vastly improved designs and technologies. On-board computer controls provide unprecedented integration of engine, transmission, and hybrid operation. Instead of slowing down, the pace of technology development just keeps accelerating.

Computer simulations will especially impact lightweight material design. In the past, interactions between the thousands of parts on the vehicles and their impacts on safety, ride, noise, and vibration were impossible to predict. Optimization of materials was a long, slow process of gradually changing a few parts at a time to avoid unanticipated problems. Secondary weight reductions were similarly difficult to achieve. The recent development of sophisticated and accurate vehicle simulations is opening up a new world. The initial use of these models was to improve safety design. The simulations are so effective that 5-star crash ratings became almost universal and NHTSA had to revise their rating criteria for the 2011 model year. The simulations are continuing to rapidly improve, to the point where they are being used to simultaneously optimize the material composition, shape, and thickness of every individual part, including secondary weight reductions.

The technology assessments performed by the agencies to inform the 2017–2025 rule were conducted four to five years ago.[1] In preparation for the mid-term term review of the U.S. 2017–2025 CAFE and GHG light-duty vehicle standards, ICCT has collaborated with automotive suppliers on a series of working papers evaluating technology progress and new developments in engines, transmissions, vehicle body design and lightweighting, and

[1] U.S. EPA & NHTSA, "Joint Technical Support Document: Final Rulemaking for 2017-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards" (2012). https://www3.epa.gov/otaq/ climate/regs-light-duty.htm#2017-2025 U.S. NHTSA, "Corporate Average Fuel Economy for MY 2017-MY 2025 Passenger Cars and Light Trucks: Final Regulatory Impact Analysis" (2012). http://www.nhtsa.gov/fuel-economy

other measures that have occurred since then. The papers combine the ICCT's extensive analytical capacity and expertise in vehicle technology with the practical knowledge and experience of auto suppliers. Each paper evaluates:

- How the current rate of progress (cost, benefits, market penetration) compares to projections in the rule;
- Recent technology developments that were not considered in the rule and how they impact cost and benefits;
- Customer-acceptance issues, such as real-world fuel economy, performance, drivability, reliability, and safety.

Eaton, Ricardo, Johnson Controls, Honeywell, ITB, BorgWarner, Dana, FEV, Aluminum Association, Detroit Materials, and SABIC have contributed to the technology papers. Papers on the following technologies are part of this series:

- Hybrid vehicles
- Downsized, boosted gasoline engines
- Naturally aspirated gasoline engines, including cylinder deactivation
- Transmissions
- Lightweighting
- Thermal management
- Diesel engines

Technology developments over the last 5 years have been astonishing. For example, the following technologies are already in production or production plans have been announced, even though were not anticipated or even considered in the supporting analyses for the 2017-25 rule:

- **High efficiency naturally aspirated engines** with Atkinson cycle and high compression ratio. The rulemaking assessments found that naturally aspirated engines would not be able to compete with turbocharged, downsized engines and would be almost completely replaced with turbocharged engines by 2025. The only exception was the continued use of Atkinson cycle engines on full hybrids (5% of the fleet), where the electric motor could offset the performance tradeoffs with the Atkinson cycle engine. However, Mazda has introduced a very high (13.0:1) compression ratio naturally aspirated engine with exceptional efficiency and is already using this on most of their vehicles. Toyota has found ways to offset the performance losses with its Atkinson cycle engine, using variable valve timing and other techniques, and is expanding the use of Atkinson cycle engines to non-hybrid vehicles. Toyota has announced that this technology will be in production soon.
- **Dynamic cylinder deactivation.** Cylinder deactivation was considered by the Agencies in the rulemaking, but only deactivation of groups of cylinders at a time. A new type of cylinder deactivation is in widespread development that allows each individual cylinder to be shut off every other revolution of the engine. This technique reduces noise and vibration, extending cylinder deactivation to lower engine rpms and allowing 4- and even 3-cylinder engines to use cylinder deactivation.
- **Miller cycle** for turbocharged engines. This is basically the higher-efficiency

Atkinson cycle concept extended to turbocharged engines. The performance tradeoff can be addressed by increasing the turbocharger boost. Miller cycle adds about 5% efficiency to a turbocharged engine at no cost, although there can be costs involved with increasing the turbocharger boost to compensate for the performance loss. If Miller cycle is combined with e-boost or 48v hybrids, these technologies provide the needed performance boost and the cost of Miller cycle becomes zero. The first Miller cycle application is in production.

- **Variable Compression Ratio (VCR).** Higher compression ratio improves efficiency, but at high engine loads it increases detonation, which is especially a problem for boosted engines. Variable compression ratio (VCR) changes the engine's compression ratio to suit particular speeds and loads. The benefits of VCR overlap with those of Atkinson/Miller cycle, as both enable higher compression ratio. However, VCR does have one significant benefit over Miller cycle – it allows performance to be completely maintained at lower engine speeds. Thus, VCR may be a competitor to Miller cycle concepts in the long run, offering manufacturers more options to improve efficiency while maintaining performance. Nissan is implementing the first VCR application in a production turbocharged engine in MY2017.[2]
- **E-boost.** These systems comprise a higher voltage electrical system (48 volt) used to provide power for a small electric compressor motor within a turbocharger. This either directly boosts the engine, or spins up the turbocharger to greatly reduce turbo lag. This increases the ability to downsize and downspeed the engine and also reduces backpressure.[3] E-boost allows the use of larger turbines with lower backpressure, for a direct reduction in BSFC in addition to the benefits from engine downspeeding/downsizing.[4] The first E-boost system application is in production.
- **48-volt hybrid systems.** Unlike expensive full hybrids, 48V hybrid systems are not designed to power the vehicle. The lack of a large electric motor and the correspondingly smaller battery greatly reduce the cost for this level of hybridization. The rulemaking considered 110-volt mild hybrid systems and projected that they would capture 17% of the market by 2025. However, 48-volt systems provide much of the same benefits at lower cost, as they stay below the 60V lethal threshold, also improving safety.[5] There are also excellent cost synergies with e-boost.
- **Continuously-variable transmissions (CVTs).** The rulemaking analyses found that CVTs would not be able to compete with other transmissions and would be completely replaced by 2025. However, certain long-standing design issues with CVTs have been resolved and the latest generation of CVTs have reduced internal friction, wider ratio spread, and increased torque capacity. These new CVT designs

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[2] Nissan Global. (2016). Infiniti VC-T: The world's first production-ready variable compression ratio engine. August 14, 2016, https://newsroom.nissan-global.com/releases/infiniti-vc-t-the-worlds-first-production-ready-variable-compression-ratio-engine

[3] BorgWarner (2015). *Technologies for enhanced fuel efficiency with engine boosting.* Presented at Automotive Megatrends USA 2015, 17 March 2015. Slide 26

[4] Telephone call with Dr. Hermann Breitbach of BorgWarner. August 4, 2016

[5] Alex Serrarens (2015). *Overview of 48V technologies, deployment and potentials.* Presented at Automotive Megatrends USA 2015, 17 March 2015.

have efficiency similar to conventional automatics and are cheaper than either conventional automatics or dual-clutch automated manuals. As a result, the CVT market share has exploded, from 9% in 2012 to 18% in 2015.

- **Lightweighting.** Advances in modeling/simulation tools and joining techniques have opened the floodgates to unprecedented levels of material/design optimization. Suppliers are rapidly developing the advanced materials and methods for major lightweighting endeavors, as well as the computational tools for simulating full vehicles all the way down to nanoscopic material behavior. Many recent vehicle redesigns have reduced weight by at least 4%, already meeting or exceeding 2021 projections in the rule (table 1). There are numerous material improvements in development that were not considered in the rule, such as higher strength aluminum, improved joining techniques for mixed materials, 3rd Generation Steels with higher strength and enhanced ductility, a new generation of ultra-high strength steel cast components, and metal/plastic hybrid components. Combined, weight reduction of about 15% should be feasible by 2025, at a cost of only about a third of the rulemaking cost projection.

Table 1: Sample of vehicle mass reductions

Vehicle make	Model year	Weight reduction (kg)*	Weight reduction (%)*	Designed market
Ford F150	2015	318	14%	US
Acura MDX	2014	111	5%	US
GM Cadillac CTS	2014	111	6%	US
Peugeot 308 SW Blue Hdi	2014	140	9%	EU
VW Golf TDI	2015	49	4%	EU
Audi Q7	2014	363	15%	US, EU
BMW i3 EV	2014	249	17%	US, EU
Land Rover Range Rover	2014	350	14%	US, EU
Porsche Cayenne	2012	181	8%	US, EU
Audi A8	2014	145	7%	US, EU
Audi A3	2014	80	6%	US, EU
Nissan Leaf	2012	80	5%	US, EU
Lamborghini Huracan	2015	78	5%	US, EU
Audi TT 3rd gen 2.0 TDI	2015	50	4%	US, EU

Production or near-production technology developments that have occurred since 2012 will make it easier and cheaper for manufacturers to comply with the 2022-25 standards. And this does not include new technologies in development, such as the VariGlide® Planetary Variator, which while unproven could improve transmission efficiency, reduce cost, and extend durability.

Novation Analytics presentation.[6]

[6] Novation Analytics. Technical Briefing: Trade Association Studies prepared for California Air

Novaton's presentation clearly defined what they did and didn't do, which I appreciate, but Novation did not actually evaluate technology potential. Instead, they simply duplicated the technology packages in the 2017-25 rulemaking and compared them to current vehicles using these technologies. There are two flaws with this approach. The first flaw is that Novation's technology assessments did not directly incorporate projected improvements in each technology from 2014 to 2025, as EPA and NHTSA did in the rulemaking. Instead, Novation started with 2014 average engine efficiencies and assumed that the average efficiency of each technology in 2025 would be the same as the 90% percentile efficiency in 2014. This implicitly assumes that there will be no improvements in the technology beyond what was already incorporated into some vehicles in 2014. This is essentially the same as saying that the iPhone7 is the best smart phone currently on the market, so in 10 years the average smart phone will be the same as the iPhone7. Applying this methodology to vehicle technology is no better than applying it to smart phones.

As a specific example, Novation's presentation stated:

> "The current CI (24-29 bar BMEP Diesel) can serve as a proxy for the efficiency of advanced SI; meaning it is unlikely that high efficiency/advanced SI with DI/Turbo/Lean Operation/Cooled EGR will exceed the CI boundary."

It is accurate that 2025 SI (spark ignited, or gasoline) engines must exceed the efficiency of current CI (compression ignition, or diesel) engines. But any competent analysis of upcoming powertrain technology (which includes transmissions and accessories, not just engines) finds that 2025 gasoline engine powertrains will exceed current diesel powertrain efficiency. Novation's conclusion makes for a good sound bite, but it has no analytical basis. For example, Novation's methodology found that the 90% percentile for naturally aspirated engines, which they used as the average efficiency for 2025 naturally aspirated engine, was 22.8% (with high-spread transmission without stop/start). However, Novation's own presentation showed that the 2014 Mazda SkyActiv engine already has an efficiency of 25.1%. This is 10% higher than Novation's 2025 estimate – and almost as high as the average 2014 diesel engine (26%) - with 11 years of improvements yet to come.

The second flaw is that Novation simply duplicated the technology set that was used in the rulemaking. As this technology set is 5 years old, Novation implicitly froze the level of innovation at the 2012 level. Not only did Novation ignore all future technology innovation, it also ignored all technology innovation that have occurred in the last 5 years.

Overall, there is some interesting information in the study on the efficiency of the 2014 fleet, but the Novation study violates both of the criteria for a good analysis – it uses old data (5-year old technology) and it assumes there will be no improvements beyond what was in the better vehicles in the 2014 fleet.

EPA/NHTSA Draft Technical Assessment Report (TAR).[7]

Resources Board, November 2, 2015 - version 1.0 -

[7] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025

There is much to commend in the updated EPA and NHTSA analyses, as documented in the TAR. Unlike Novation, both agencies have done massive amounts of work to update the technologies and the technology assessments since the 2017-25 rulemaking. The most significant change was the addition of new highly-efficient, cost-effective naturally aspirated engines (i.e. high compression Atkinson engines, like Mazda's SkyActiv) in EPA's analyses. This resulted in a reduction in the penetrations of turbo downsizing and hybridization for the EPA modeling. Both agencies also implemented a number of other updates, including:

- A more cost effective Mild Hybrid, based on a 48V system.
- Addition of Miller cycle turbocharged engines, based upon the engine map published by VW on their 2016 2.0L EA888 engine. This technology was applied to 4% of the 2025 fleet in EPA's OMEGA analysis.
- Addition of variable geometry turbocharges (VGT) on 24-bar turbocharging systems.
- Updated mass reduction costs, based on 4 independent teardown studies. At lower levels of mass reduction, these studies produced lower costs than the rulemaking estimates.
- Increased effectiveness of future 8-speed transmissions, as informed by benchmarking of multiple transmissions, published reports of future planned improvements by ZF, and results from EPA's new physics-based Alpha model.
- A significant reduction in battery cost estimates for EVs and PHEVs as a result of updated battery and motor sizing estimates, and the application of DOE's latest version of the BatPaC model.
- Improved on-cycle effectiveness estimates for stop-start, based on more recent implementations of the technology

Due to the improved technology and cost reductions since the rulemaking, the standards will be easier and cheaper to meet than originally anticipated. This is illustrated by EPA's technology forecasts in the TAR, which include only 4% penetration for Miller cycle and 7% weight reduction by 2025. If necessary, Miller cycle could be extended to all turbocharged engines (37% of the market forecast for 2025) and 15% weight reduction is also feasible by 2025, thus only a relatively small amount of these technologies are needed to meet the 2025 standards.

Another important finding from the TAR is that the MY2022-2025 standards are not dependent on any single technology. There are multiple promising technology pathways that have similar cost-effectiveness, and there are already several examples where different strategies employed by manufactures have produced competition in innovation, such as automatic transmissions versus CVTs, downsized turbocharger versus Atkinson cycle naturally aspirated, and high-strength steel versus aluminum.

The agencies are also to be commended for their expanded use of rigorous peer-reviewed "tear-down" cost studies. Although expensive to conduct, these studies are more accurate and far more transparent than the older method of surveying manufacturers. Note that the

2015 National Academy of Science report specifically endorsed tear-down studies as the most appropriate way to get at costs.

Still, despite all of their new work and all of the updates, the agencies are still behind what is already happening in the market. For example, the agencies did not explicitly model e-boost, variable compression ratio, or dynamic cylinder deactivation. This is understandable, as it is critical for the agencies to have a robust, defensible analysis. But it also means that the agencies are always going to be somewhat behind in their assessments of potentially promising technologies. This may be particularly a concern for the NHTSA results, as it appears that NHTSA used slightly older data for some of their analyses and did not model the new high compression ratio naturally aspirated engines. On the other hand, EPA and NHTSA showing relatively similar results, even though they conducted fairly independent analyses. This supports the robustness of the technology availability to comply with the 2025 standards.

Although the agencies' results are conservative, they are far more up to date and accurate than the Novation study.

CONSUMER IMPACTS

The argument is often raised that higher vehicle costs due to addition of efficiency technology will cause customers to keep their old vehicles longer, reducing the effectiveness of the standards and costing manufacturers sales. However, this argument is accurate only if the technology does not deliver benefits desired by consumers. In fact, even at the current relatively low fuel prices, the monthly savings in fuel costs more than pays for the increase in the vehicle monthly payment. Most customers will recognize the improved vehicle fuel economy and will not balk at the increased vehicle price. It should be noted that the aggressive standards implemented from 2012 to 2016 coincided with the longest and strongest vehicle sales increase in history.

More importantly, many of the technologies required by the standards have other attributes that are highly desired by consumers. Turbocharged engines are downsized to deliver the same amount of power at high engine speeds. However, turbochargers have more power at low engine speeds and, thus, accelerate faster, climb steeper hills without having to downshift the transmission, and provide more towing ability. This effect was dramatically illustrated with a recent high-volume turbocharger application, the Ford 3.5L EcoBoost engine offered on their F150 pickup truck. The 3.5L V6 turbocharged engine was an optional engine on the F150. Ford charged an extra $595 over the standard 5.0L V8 engine. Ford originally expected that 20% of customers would pay the additional $595 for the smaller engine. The reality was that 45% of F150 customers paid $595 for the 3.5L EcoBoost and sales were higher than the standard 5.0L V8 (the F150 offered two other engines that combined for about 15% of sales, with 40% for the 5.0L V8). Certainly the better efficiency of the smaller engine was desirable, but what most customers wanted was the higher low rpm torque and higher towing capacity of the 3.5L EcoBoost.

Many other engine technologies, such as gasoline direct injection, variable valve timing, variable valve lift, and cooled EGR, also provide improved vehicle performance in addition to the efficiency benefits. Thus, there are no consumer acceptance issues for these technologies.

New transmissions with more gear ratios and wider gear spread have major positives in addition to better fuel economy. Lower gears improve vehicle launch, a lower ratio for the top gear provides quieter operation on the highway, and more gears can better maintain both lower rpm for better fuel economy and higher rpm for faster acceleration. These advantages have contributed to the rapid adoption of more gear ratios in recent years.

Lightweighting has very large benefits, beyond fuel savings, that have substantial value to customers. These includes better acceleration, ride, handling, and braking, as well as higher towing and payload capacity. For the 2025 rule and in the TAR, EPA and NHTSA did not evaluate the value of these benefits to consumer, instead assigning the entire cost of lightweighting to fuel consumption/CO2 reductions. This is not appropriate and dramatically understates the benefits of lightweighting to consumers and overstates the cost to reduce fuel consumption and CO2.

This is supported by a 2015 report published by the National Academy of Sciences (NAS),[8], which projected that manufacturers will reduce light-truck mass by 20% in 2025, despite very high cost ($1,617–$2,343 for a 5,550 pound truck). They reached this determination because "implementation of mass reduction techniques can provide several benefits that might be attractive to an OEM".

As a specific example, the official Ford website for their F150 pickup truck[9] does not even mention improved fuel economy when discussing the aluminum body benefits on the front webpage:

> "THE MATERIAL THAT MADE EVERY OTHER TRUCK HISTORY"
> "The use of high-strength, military-grade, aluminum alloy not only makes F-150 lighter and more agile than ever before, it's also one of the reasons it can haul and tow more than any other half-ton pickup. See the story of this revolutionary advance in truck manufacturing."

SAFETY

Safety should no longer be an issue, due to indexing the standards to footprint. Older studies reported that reducing vehicle weight increased fatalities, but these studies inappropriately grouped the effects of vehicle size with weight and reported both effects as a weight effect. More recent studies by NHTSA and DRI have found that it was the smaller vehicle size that increased fatalities, not reducing weight. The footprint-based standards

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[8] National Research Council. *Cost, Effectiveness, and Deployment of Fuel Economy Technologies for Light-Duty Vehicles*. Washington, DC: The National Academies Press, 2015. doi:10.17226/21744. (see pp. 6-10, specifically).
[9] http://www.ford.com/trucks/f150/

were deliberately designed to create a safer fleet, as they encourage larger but lighter vehicles and there is no longer any incentive to downsize vehicles. This is exactly what you want to reduce fatalities. The latest draft NHTSA report on the impacts of size and weight on fatalities found that if size is held constant, then the impacts of reducing weight on fatalities are statistically insignificant.[10]

The draft NHTSA report also found that older data may not be representative of future vehicles subject to footprint-based standards:

> (viii) "The vehicles manufactured in the 2003-2010 timeframe were not subject to a footprint-based fuel-economy standard. NHTSA and EPA expect that the attribute-based standard will affect the design of vehicles such that manufacturers may reduce mass while maintaining footprint more than has occurred prior to 2022-2025. Therefore, it is likely that the analysis for 2003-2010 vehicles may not be fully representative of those vehicles that interact with the existing fleet in 2022 and beyond."

An important factor that is rarely addressed is that future weight reductions will be accomplished primarily with the use of high strength steel and aluminum and with better vehicle design. High strength steel and aluminum both have better crash properties than standard steel. Reducing weight using these better materials will improve vehicle crash performance and reduce fatalities, even in small cars.

FULL HYBRIDS AND PLUG-IN VEHICLES

Much has been made of the market drop in full hybrid vehicles, corresponding to the drop in fuel prices. While full hybrids are sensitive to fuel prices, this is a very expensive technology that is not typical of the technologies available to comply with the standards. Most technologies are much lower cost and will not engender the same consumer resistance. This includes 48V hybrids that are only about 40% of the cost of a full hybrid.

The manufacturers have been quoting the Novation study results, which found that 30% full hybrids would be needed to meet the 2025 standards. However, this study is based on 2012 technology sets and also assumes little improvement in technologies from 2014 to 2025. The best way to find that a lot of full hybrids are needed is to use outdated data and assumptions that cause the amount of available conventional technology to run out, which is exactly what Novation did. In reality, there are many technologies that have become available since 2012, which will allow the standards to be met without the need for full hybrids.

Neither full hybrids nor plug-in vehicles are needed to comply with the standards. Between the technologies that are already near production that were not included in the agencies' assessments in the TAR and the low penetration of Miller cycle and weight reduction projected for 2025, conventional technology will be more than enough for manufacturers

[10] Reference NHTSA draft safety report

to comply with the standards.

Plug-in vehicles required by California's ZEV mandate are built into the EPA Reference Case fleet for the TAR. This is a constructive change from the assumptions in the 2017-2025 rule, as it ensures that EPA is not double-counting policy costs incurred by a different regulation (the ZEV mandate). These vehicles also make it easier for manufacturers to comply with the CAFE/CO2 standards.

OFF-CYCLE CREDITS

The vehicle manufacturers have petitioned EPA to streamline the off-cycle credit approval process. Due to the current lack of data on how vehicles are actually operated in the real world, approval of this petition would be counter-productive.

In theory, off-cycle credits are a good idea, as they encourage real world fuel consumption reduction for technologies that are not fully included on the official test cycles. However, real world benefits only accrue if double-counting is avoided and the amount of the real world fuel consumption reduction is accurately measured. The problem is that there has not been any systematic study of driving conditions and consumer driving behavior for at least 25 years. This lack of data makes it difficult, if not impossible, to establish generic credits. It also provides an incentive for manufacturers to generate real world data on a biased sample of in-use vehicles, in order to obtain artificially large credits.

The proper solution is for EPA to launch a collaborative data collection program, in cooperation with the manufacturers and the Department of Energy, to collect real world data representative of national driving behavior and conditions. This data set would allow EPA to establish standardized credits that would apply to all manufacturers and would not be subject to gaming. The ICCT would be happy to collaborate in such as data collection program. But any effort to streamline the off-cycle credit approval process must be contingent upon gathering this data.

To: Safoutin, Mike[safoutin.mike@epa.gov]
Cc: Bolon, Kevin[Bolon.Kevin@epa.gov]; Olechiw, Michael[olechiw.michael@epa.gov]; Wysor, Tad[wysor.tad@epa.gov]; Caffrey, Cheryl[caffrey.cheryl@epa.gov]
From: Moran, Robin
Sent: Thur 6/2/2016 11:16:57 AM
Subject: RE: CARB's update FCEV and road load study sections

Hi Mike, thank you, and I'm fine with the approach of putting this CARB piece in an Appendix.

Ex. 5 - Deliberative Process

I'll defer to Mike O on the Novation write-up below.

Thanks

From: Safoutin, Mike
Sent: Wednesday, June 01, 2016 3:13 PM
To: Moran, Robin <moran.robin@epa.gov>
Cc: Bolon, Kevin <Bolon.Kevin@epa.gov>; Olechiw, Michael <olechiw.michael@epa.gov>; Wysor, Tad <wysor.tad@epa.gov>; Caffrey, Cheryl <caffrey.cheryl@epa.gov>
Subject: RE: CARB's update FCEV and road load study sections

Robin,

- I've incorporated the new FCEV section into the TAR.

Ex. 5 - Deliberative Process

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Ex. 5 - Deliberative Process

From: Moran, Robin
Sent: Tuesday, May 31, 2016 3:48 PM
To: Safoutin, Mike <safoutin.mike@epa.gov>
Cc: Bolon, Kevin <Bolon.Kevin@epa.gov>; Olechiw, Michael <olechiw.michael@epa.gov>; Wysor, Tad <wysor.tad@epa.gov>

Subject: CARB's update FCEV and road load study sections

Mike S – here's CARB latest FCEV section, and a write-up on their control tec study that Kevin and I thought might best fit in the road load (tire, aero etc) section of Ch. 5?

See what you think.

Tad, note Ch. 9 is coming later today….

From: McCarthy, Mike@ARB [mailto:michael.mccarthy@arb.ca.gov]
Sent: Tuesday, May 31, 2016 2:55 PM
To: Moran, Robin <moran.robin@epa.gov>
Cc: Olechiw, Michael <olechiw.michael@epa.gov>; Bolon, Kevin <Bolon.Kevin@epa.gov>
Subject: updated TAR sections

Attached is:

1. Revised FCEV technology portion for Chapter 5.

2. Expanded control-tec contract write-up we talked about for you to try and find a home in the TAR.

Still to come today is updated chapter 9 infrastructure.

---

[i] Novation Analytics, "Technology Effectiveness – Phase I: Fleet-- - Level Assessment," contract for the Alliance of Automobile Manufacturers and the Association of Global Automakers, October 19, 2015

To: Moran, Robin[moran.robin@epa.gov]
Cc: Bolon, Kevin[Bolon.Kevin@epa.gov]; Olechiw, Michael[olechiw.michael@epa.gov]; Wysor, Tad[wysor.tad@epa.gov]; Caffrey, Cheryl[caffrey.cheryl@epa.gov]
From: Safoutin, Mike
Sent: Wed 6/1/2016 7:13:24 PM
Subject: RE: CARB's update FCEV and road load study sections

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Subject: updated TAR sections

Attached is:

1. Revised FCEV technology portion for Chapter 5.

2. Expanded control-tec contract write-up we talked about for you to try and find a home in the TAR.

Still to come today is updated chapter 9 infrastructure.

---

[i] Novation Analytics, "Technology Effectiveness – Phase I: Fleet-- - Level Assessment," contract for the Alliance of Automobile Manufacturers and the Association of Global Automakers, October 19, 2015

To: Charmley, William[charmley.william@epa.gov]
Cc: Moran, Robin[moran.robin@epa.gov]; Bolon, Kevin[Bolon.Kevin@epa.gov]; Barba, Daniel[Barba.Daniel@epa.gov]
From: Olechiw, Michael
Sent: Tue 5/24/2016 2:21:30 PM
Subject: FW: Auto Alliance presentation to CARB
Novation_Analytics_Trade_Association_Technical_Briefing_CARB_17may2016_v1.0.key.pdf

Bill,

The Alliance/Novation presentation is attached.

Mike

From: Moran, Robin
Sent: Thursday, May 19, 2016 11:23 AM
To: Midterm Review <Midterm_Review@epa.gov>
Subject: Auto Alliance presentation to CARB

Team,

This is the full briefing the Auto Alliance presented with their contractor, Novation Analytics, on Tuesday.

From: McCarthy, Mike@ARB [mailto:michael.mccarthy@arb.ca.gov]
Sent: Wednesday, May 18, 2016 11:07 AM
To: Olechiw, Michael <olechiw.michael@epa.gov>; Bolon, Kevin <Bolon.Kevin@epa.gov>; james.tamm@dot.gov
Cc: Moran, Robin <moran.robin@epa.gov>; Barba, Daniel <Barba.Daniel@epa.gov>; Kevin.Green@dot.gov
Subject: FW: Presentation

FYI—share among your teams as needed.

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

From: Greg Pannone [mailto:gpannone@novationanalytics.com]
Sent: Tuesday, May 17, 2016 2:17 PM
To: McCarthy, Mike@ARB
Subject: Presentation

Gregory Pannone | President

novation analytics

2851 High Meadow Circle, Suite 160

Auburn Hills, MI 48326

M 313.910.3280

novationanalytics.com

To: Moran, Robin[moran.robin@epa.gov]
Cc: Cherry, Jeff[Cherry.Jeff@epa.gov]; Bolon, Kevin[Bolon.Kevin@epa.gov]; Olechiw, Michael[olechiw.michael@epa.gov]
From: McDonald, Joseph
Sent: Thur 5/19/2016 4:06:11 PM
Subject: Re: Auto Alliance presentation to CARB

Ex. 5 - Deliberative Process

Joseph McDonald
Senior Engineer

U.S. EPA
ORD/NRMRL & OAR/OTAQ
Mail Stop 236
26 W. Martin Luther King Dr.
Cincinnati, OH 45268 USA

Telephone: 513-569-7421
Cellular Telephone: Ex. 6 - Personal Privacy
E-mail: mcdonald.joseph@epa.gov

> On May 19, 2016, at 11:22 AM, Moran, Robin <moran.robin@epa.gov> wrote:
>
> Team,
>
> This is the full briefing the Auto Alliance presented with their contractor, Novation Analytics, on Tuesday.
>
> From: McCarthy, Mike@ARB [mailto:michael.mccarthy@arb.ca.gov]
> Sent: Wednesday, May 18, 2016 11:07 AM
> To: Olechiw, Michael <olechiw.michael@epa.gov>; Bolon, Kevin <Bolon.Kevin@epa.gov>; james.tamm@dot.gov
> Cc: Moran, Robin <moran.robin@epa.gov>; Barba, Daniel <Barba.Daniel@epa.gov>; Kevin.Green@dot.gov
> Subject: FW: Presentation
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> Sent: Tuesday, May 17, 2016 2:17 PM
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>
>
> Gregory Pannone | President
> novation analytics
> 2851 High Meadow Circle, Suite 160
> Auburn Hills, MI 48326
> M 313.910.3280
> novationanalytics.com<http://novationanalytics.com>
> <Novation_Analytics_Trade_Association_Technical_Briefing_CARB_17may2016_v1.0.key.pdf>

To: Olechiw, Michael[olechiw.michael@epa.gov]; Bolon, Kevin[Bolon.Kevin@epa.gov]; james.tamm@dot.gov[james.tamm@dot.gov]
Cc: Moran, Robin[moran.robin@epa.gov]; Barba, Daniel[Barba.Daniel@epa.gov]; Kevin.Green@dot.gov[Kevin.Green@dot.gov]
From: McCarthy, Mike@ARB
Sent: Wed 5/18/2016 3:07:20 PM
Subject: FW: Presentation
Novation_Analytics_Trade_Association_Technical_Briefing_CARB_17may2016_v1.0.key.pdf

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2851 High Meadow Circle, Suite 160

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To: Olechiw, Michael[olechiw.michael@epa.gov]
Cc: Giedrius Ambrozaitis[gambrozaitis@autoalliance.org]; 'Greg Pannone'[gpannone@novationanalytics.com]; Julia Rege[jrege@globalautomakers.org]; Michael Hartrick[MHartrick@autoalliance.org]; McDonald, Joseph[McDonald.Joseph@epa.gov]; Kargul, John[kargul.john@epa.gov]; Barba, Daniel[Barba.Daniel@epa.gov]; Nam, Ed[nam.ed@epa.gov]; Bolon, Kevin[Bolon.Kevin@epa.gov]; Charmley, William[charmley.william@epa.gov]; Moran, Robin[moran.robin@epa.gov]
From: Chris Nevers
Sent: Thur 4/14/2016 7:51:20 PM
Subject: RE: Meeting with the Alliance regarding MTE related analysis

Mike,

No problem. I'll circle back with Mike McCarthy and make sure he provided a call-in to both EPA and NHTSA for the May 17 meeting. The offer to come in and talk to EPA (in person) still stands.

Chris

From: Olechiw, Michael [mailto:olechiw.michael@epa.gov]
Sent: Thursday, April 14, 2016 2:30 PM
To: Chris Nevers; Bolon, Kevin; Ed Nam; Moran, Robin; Barba, Daniel; Joseph McDonald; Kargul, John
Cc: Giedrius Ambrozaitis; 'Greg Pannone'; Julia Rege; Michael Hartrick; Bill Charmley
Subject: RE: Meeting with the Alliance regarding MTE related analysis

Chris,

Thank you for reaching out again. I are interested in meeting with you, however, I was under the impression that it would be 3-agency meeting coordinated by you and CARB. I was anticipating a meeting notice from either you or Mike McCarthy.

Please let me know if this is not the case and we can make alternate plans. (I would still like the meeting to be 3-agency.)

Best Regards,

Mike

Michael R. Olechiw

Director - Light-duty Vehicles and Small Engines Center

USEPA/OTAQ/ASD

2000 Traverwood Drive

Ann Arbor MI 48105

Tel: +1-734-214-4297

Mobile: +1-734-546-8079

Fax: +1-734-214-4050

olechiw.michael@epa.gov

From: Chris Nevers [mailto:CNevers@autoalliance.org]
Sent: Thursday, April 14, 2016 1:52 PM
To: Olechiw, Michael <olechiw.michael@epa.gov>; Bolon, Kevin <Bolon.Kevin@epa.gov>; Nam, Ed <nam.ed@epa.gov>; Moran, Robin <moran.robin@epa.gov>; Barba, Daniel <Barba.Daniel@epa.gov>; McDonald, Joseph <McDonald.Joseph@epa.gov>; Kargul, John <kargul.john@epa.gov>
Cc: Giedrius Ambrozaitis <gambrozaitis@autoalliance.org>; 'Greg Pannone' <gpannone@novationanalytics.com>; Julia Rege <jrege@globalautomakers.org>; Michael Hartrick <MHartrick@autoalliance.org>; Charmley, William <charmley.william@epa.gov>
Subject: RE: Meeting with the Alliance regarding MTE related analysis

Hello Mike,

I hope this email finds you well.

I haven't heard anything back from anyone at the EPA regarding the below request to meet. Perhaps I missed the reply?

Is EPA open to a briefing from both trade associations? May 5th is still open (anytime that is convenient for you). We could also meet at EPA Ann Arbor or the Alliance Southfield offices.

Best Regards,

Chris Nevers

Vice President, Energy and Environment

Alliance of Automobile Manufacturers

248-794-5002

From: Chris Nevers
Sent: Monday, March 28, 2016 4:25 PM
To: 'Olechiw, Michael'; Bolon, Kevin; Ed Nam; Moran, Robin; Barba, Daniel; Joseph McDonald; Kargul, John
Cc: Giedrius Ambrozaitis; 'Greg Pannone'; Julia Rege; Michael Hartrick (MHartrick@autoalliance.org); 'Charmley, William'
Subject: RE: Meeting with the Alliance regarding MTE related analysis

Hello Mike,

As a follow up to some recent conversation and our last MTE discussion, I was hoping to set up a date to discuss our most recent modeling results. We had hoped to have our analysis completed by February of this year (as communicated in the December MTE discussion), but it has slipped to the end of April. Would either May 3 or 5 work for an EPA/ industry meeting? If you had a date/time/location that worked particularly well for you, we would try to accommodate.

I expect to need 2-3 hours to go through all the material and answer any questions you may have. Our analysis shows a substantially higher cost of compliance to the GHG\CAFE regulations in years 2022-2025 than was initially predicted in the 2017-2025 rulemaking (this using agency technology costs with new updated technology effectiveness values). I am sure this finding will generate some productive Q&A.

I also want to take this opportunity to introduce the Alliance's new Director of Climate and Fuel Economy, Mike Hartrick. Mike, a chemical engineer by education, comes to the Alliance from FCA with over 15 years of experience in all things GHG and ZEV. Mike will be the primary Alliance GHG/CAFE contact and subject matter expert going forward.

Proposed agenda

1. Recent Technology Effectiveness Updates (Novation)
2. Interpretation of Results (Trade Associations)
3. Modeling Plausibility Checks (Novation)
4. Next Steps

a. 2015 and 2016MY updates (Novation)

b. Cost modeling data share (TA)

c. Consumer Acceptance (TA)

Best Regards,

Chris Nevers

Vice President, Energy and Environment

Alliance of Automobile Manufacturers

248-794-5002

-----Original Appointment-----
From: Olechiw, Michael [mailto:olechiw.michael@epa.gov]
Sent: Thursday, October 22, 2015 1:13 PM
To: 'Olechiw, Michael'; Chris Nevers; Bolon, Kevin; Ed Nam; Moran, Robin; Barba, Daniel; Joseph McDonald; Julia Rege; Kargul, John; Giedrius Ambrozaitis; Greg Pannone
Subject: Meeting with the Alliance regarding MTE related analysis
When: Tuesday, December 08, 2015 1:00 PM-3:30 PM (UTC-05:00) Eastern Time (US & Canada).
Where: AA-Room-Office-N66-ConfRoom/AA-OTAQ-OFFICE

Novation Analytics to be in attendance.

To: Chris Nevers[CNevers@autoalliance.org]; Bolon, Kevin[Bolon.Kevin@epa.gov]; Nam, Ed[nam.ed@epa.gov]; Moran, Robin[moran.robin@epa.gov]; Barba, Daniel[Barba.Daniel@epa.gov]; McDonald, Joseph[McDonald.Joseph@epa.gov]; Kargul, John[kargul.john@epa.gov]
Cc: Giedrius Ambrozaitis[gambrozaitis@autoalliance.org]; 'Greg Pannone'[gpannone@novationanalytics.com]; Julia Rege[jrege@globalautomakers.org]; Michael Hartrick[MHartrick@autoalliance.org]; Charmley, William[charmley.william@epa.gov]
From: Olechiw, Michael
Sent: Thur 4/14/2016 6:30:22 PM
Subject: RE: Meeting with the Alliance regarding MTE related analysis

Chris,

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Mike

Michael R. Olechiw

Director - Light-duty Vehicles and Small Engines Center

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olechiw.michael@epa.gov

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Sent: Thursday, April 14, 2016 1:52 PM
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Alliance of Automobile Manufacturers

248-794-5002

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Novation Analytics to be in attendance.

To: Bolon, Kevin[Bolon.Kevin@epa.gov]
Cc: Olechiw, Michael[olechiw.michael@epa.gov]; Barba, Daniel[Barba.Daniel@epa.gov]
From: Moskalik, Andrew
Sent: Mon 12/21/2015 4:22:56 PM
Subject: RE: Novation methodology

Apparently CARB has commissioned Novation to do a study where they "analyzed all available vehicles in the 2014 model year, identified the better performers in class-specific road load characteristics, and then upgraded the entire vehicle fleet to nominally have best-in-class aerodynamics, tire rolling resistance, and mass efficiency."

Ex. 5 - Deliberative Process

-AM

From: Bolon, Kevin
Sent: Monday, December 14, 2015 8:52 AM
To: Moskalik, Andrew
Cc: Olechiw, Michael; Barba, Daniel
Subject: RE: Novation methodology

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

From: Moskalik, Andrew
Sent: Monday, December 14, 2015 7:27 AM
To: Bolon, Kevin
Cc: Olechiw, Michael; Barba, Daniel
Subject: Novation methodology

Ex. 5 - Deliberative Process

=====================

Andrew Moskalik, PhD, PE

US Environmental Protection Agency, NVFEL

2565 Plymouth Rd

Ann Arbor, MI 48105

(734) 214-4719

To: Mike McCarthy[mmccarth@arb.ca.gov]
From: Bolon, Kevin
Sent: Thur 1/5/2017 10:07:15 PM
Subject: FW: Novation Analytics Comments
Novation_Analytics.pdf

From: Lieske, Christopher
Sent: Saturday, December 31, 2016 7:45 AM
To: Bolon, Kevin <Bolon.Kevin@epa.gov>; Olechiw, Michael <olechiw.michael@epa.gov>; Moran, Robin <moran.robin@epa.gov>
Subject: Novation Analytics Comments

novation analytics

December 30, 2016

Via Federal Rulemaking Portal: http://www.regulations.gov
Docket ID No. EPA-HQ-OAR-2015-0827

The Honorable Gina McCarthy
Administrator, U.S. Environmental Protection Agency
Office of the Administrator 1101A
1200 Pennsylvania Avenue, N.W.
Washington DC 20460

Christopher Lieske
Office of Transportation and Air
Quality Assessments and Standards Division
U.S. Environmental Protection Agency
2000 Traverwood Drive
Ann Arbor, MI 48105

RE: Novation Analytics' Comments on the Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation (Docket ID No. EPA-HQ-OAR-2015-0827)

Dear Administrator McCarthy and Mr. Lieske:

The United States Environmental Protection Agency's ("EPA") Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards Under the Midterm Evaluation ("Proposed Determination") includes an Appendix A [1] [1] dedicated to two studies conducted by Novation Analytics ("Novation") [2, 3]. Much of what is presented in Appendix A (and referenced in the body of the Proposed Determination) is based on misrepresentations of the methodologies used by Novation in the two studies. For your convenience, a short comparison of EPA's critiques, alongside of Novation's actual methods, are presented in the table below. A more detailed analysis is found in the attached document.

[1] Values in brackets [ ] denote references found at the end of the attached document

EPA Critique	Novation Analytics' Actual Method
The studies did not assume advancement of powertrain technologies and, therefore, minimal advancement of powertrain effectiveness.	The studies did assume technology advancement, evaluating agency-defined powertrains from the final rule-making ("FRM") [4, 5]. The resulting effectiveness levels were as much as 33% greater than the MY 2014 averages.
The studies assumed only MY 2014 powertrains and did not allow for the recombination of technologies.	The studies did not assume only MY 2014 powertrain combinations: powertrain maps were developed for technology combinations described in the FRM.
The studies omit vehicle load technologies.	The studies included vehicle load technology advancements and used the same loads described in the FRM.
The studies' constraints are arbitrary and lack technical foundation.	The studies' constraints are not arbitrary; all constraints were cited and accounted for, some based on EPA published data.

As background, Novation is a policy-neutral organization and our clients for the Mid-Term Evaluation ("MTE") include the California Air Resources Board ("CARB"), the Alliance of Automobile Manufacturers ("Alliance"), the Global Automakers, and the Department of Transportation ("DoT") through the Volpe National Transportation Center ("Volpe"). Furthermore, Novation's (formerly Control-Tec) prior work for CARB [6] was used to support the development of the draft Technical Assessment Report ("TAR") [7]. An element of this study was used by EPA in the Proposed Determination; however, EPA chose not to reference the original work.

In the spirit of collaboration, any data or process issues found during the course of these studies were communicated to all stakeholders (prior to the draft TAR), with the goal of enhancing the MTE process. The results of the studies were shared, as early as March 2015, with all three stakeholder agencies. Specifically, Novation conducted multiple on-site visits to CARB (Sacramento, CA), EPA (Ann Arbor, MI), Volpe (Cambridge, MA), and the National Highway Traffic Safety Administration ("NHTSA") (Washington, DC).

Additionally, the Alliance, Global Automakers, and Novation repeatedly offered their time to answer any questions regarding the two studies. The EPA team did not respond to these offers. Despite our overtures, EPA's critiques are largely based on blogs [8,9], rather than fact-checked and peer-reviewed sources.

Given these facts, which are presented in more detail in the attachment, EPA must retract and correct its characterizations of Novation's methods in accordance with the attached.

Respectfully submitted,

Greg Pannone
President, Novation Analytics
2851 High Meadow Circle, Suite 160
Auburn Hills, MI 48326

Introduction

The United States Environmental Protection Agency's ("EPA") Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards Under the Midterm Evaluation ("Proposed Determination") includes an appendix [1, Appendix A] dedicated to two studies conducted by Novation Analytics ("Novation") [2, 3]. The evaluation of the studies by EPA include misrepresentations of the actual methods and assumptions employed by Novation.

The Novation studies referenced in Appendix A, and elsewhere in the Proposed Determination, were requested by the Alliance of Automobile Manufacturers ("Alliance") and Global Automakers, and are a retrospective evaluation of the model years ("MY") 2012 to 2025 final rule-making ("FRM") [4, 5] modeling results. The objective of the studies was to provide an independent review of the FRM processes with the goal of improving the efficacy of the Mid-Term Evaluation ("MTE") process. The studies were not an assessment of the draft Technical Assessment Report ("TAR") [7] or any other work generated by the agencies following the publication of the FRM.

EPA's main argument is that Novation simply assumed MY 2014 technology and levels of powertrain efficiency, making no consideration for powertrain and vehicle load technology advancements. On the contrary, the Novation studies assumed:

1. The same powertrain technology pathways published in the FRM, which included aggressive turbocharging with engine displacement downsizing, high efficiency and high ratio spread transmissions, stop-start, and multiple levels of electrification.
2. The same vehicle load reductions published in the FRM, which included aerodynamic drag and tire rolling resistance reductions of up to 20% in addition to mass reductions of up to 10%.

The conclusions and recommendations from these reports can be summarized as follows:

Conclusions

1. The powertrain technology pathways published in the FRM are not sufficient to support the MY 2021 and 2025 standards.
2. Based on conclusion #1, more efficient powertrain technologies than assumed by the FRM (and using the agency assumptions for mass reduction, aerodynamic drag reduction, and tire rolling resistance reduction) will be required to achieve the standards.
3. Conclusion #1 is the result of FRM process issues associated with the vehicle-level modeling for fuel economy and tailpipe CO_2 emissions. Two particular areas of concern are:
   a. The lumped parameter model ("LPM") [10] has fundamental deficiencies that cause under-projection of tailpipe CO_2 for many individual vehicles.
   b. The Ricardo modeling results [11] used to calibrate the LPM for the FRM fail basic plausibility checks.

Recommendations

1. Upgrade the LPM or replace it with another modeling method.
2. Remove the Ricardo modeling results from MTE evaluations.
3. Utilize powertrain efficiency to assess the sustainability of vehicle modeling results.

EPA has acknowledged recommendations #1 and #3 and has attempted to incorporate them into its modeling and quality control processes.

Specific feedback to Appendix A subsections are provided in the next sections.

A.1 Constraints on Technology Combinations and Technological Innovation

EPA's representation of Novation's assumption of non-advancement of technology is incorrect. These statements were also made by David Cooke [8].

EPA states [1, pages A-1, A-2]:

"*The most basic of the "fundamental mistakes" in the report, and one that directly affects all of the conclusions drawn by the Alliance on projected technology effectiveness, is the contention that all possible technology available in 2025 can be represented by technology already contained in the MY2014 baseline fleet ...*

... The methodology in the Novation report does not allow for the recombination of technologies represented by these packages, and thus severely and unduly limits potential effectiveness increases obtainable by MY2025."

This mimics David Cooke's blog [8]:

"The study assumes that over an 11 year span from 2014 to 2025, the average vehicle will not improve upon what is already available today. This is said with a straight face, despite noting at other points in the fact sheet "the industry's innovations" and how "manufacturers have accelerated the development of new technology.""

"*Among its seemingly arbitrary constraints, the study assumes that conventional vehicles will never match the levels of efficiency of today's diesel or hybrid-electric powertrains. Engineers have already previously broken this "constraint," with the Southwest Research Institute's HEDGE project matching diesel equivalency and Toyota's ESTEC platform matching the same level of efficiency as its Prius—there's no reason to accept such a limit at face value.*"

On the contrary, Novation modeled the agencies' FRM packages using alternative simulation methods and assumptions. Furthermore, Novation used the current powertrains as a foundation upon which it added the technologies assumed by the FRM. This is fundamentally the same process that the agencies use: measure the performance of current production powertrains and powertrain components to establish a baseline, then add those technologies and technology combinations that do not exist in the fleet today. The difference is simply system-level analysis versus component-level analysis. Questioning the validity of Novation's process of creating powertrain maps (actual baseline plus new technologies) suggests that EPA would also question its own approach.

As stated in the Executive Summary of the first Novation report [2, page 7]:

"Novation Analytics' full vehicle simulation software was utilized to model conversion efficiencies for each of the technology bundles considered by the agencies. The foundation of the powertrain efficiency maps used in the simulation software is data from thousands of actual production vehicle tests, providing an accurate fleet level assessment of conversion efficiency for a given technology implemented in a production, regulatory-compliant and customer acceptable application. Future technologies are layered onto this foundation and, through statistical analysis of powertrain efficiency, powertrain integration learning can be applied."

Novation used its ENERGY™ simulation software to generate the efficiency domain projections of the FRM technology pathways. ENERGY™ is a full-vehicle simulation software and, similar to EPA's ALPHA model [1, section 2.3.3.3], requires powertrain energy maps, vehicle load elements, and drive cycle details (e.g., vehicle speed versus time).

Novation goes on to describe the building of the maps, including combinations of technologies, to account for key information missing from the FRM including basic powertrain parameters required by any sustainable analysis including, but not limited to, engine displacement, compression ratio, and boost pressure [2, page 47]:

"The foundation of the powertrain maps is actual tests results that have been decomposed to the physics-based subsystem and feature contributions, analyzed and re-assembled as maps and analytics. Incorporating technology benefits reported from technical publications and other sources further enhances these maps. This approach creates a powerful tool calibrated to actual test results and capable of building and evaluating not only powertrain combinations that exist in the fleet today but also combinations that may be considered in the future, such as a compression ignition hybrid."

Table XIII [2, page 57] in the Novation report clearly shows the efficiency values resulting from the modeling. Novation found plausible cycle average efficiencies of up to 28.2% for advanced spark-ignition (SI) based powertrains with high ratio spread transmissions and stop start. This is 33% greater than the average of SI-based powertrains in MY 2014. These powertrain combinations are not in production nor do any current non-hybrid SI-based applications approach these cycle average efficiency levels. Novation's analysis of the FRM powertrain combinations was limited to an evaluation of efficiency and not, as EPA suggested [1, page A1], on the cost and production viability.

Contrary to David Cooke's statements, there are no production-viable products that have "*broken this constraint*" (HEDGE is not in production). The most efficient MY 2016 light-duty gasoline vehicle has an average cycle efficiency of 25.8% (combined cycle). Furthermore, by starting from a diesel map (the proxy), Novation is assuming diesel-like efficiency for an SI-based powertrain. By comparison, the average diesel powertrain in MY 2016 was 27.6% (combined cycle) against Novation's result of a 28.2% average for the best advanced SI-based powertrain studied. Cooke also incorrectly states that Toyota's Atkinson-cycle ESTEC platform matches the efficiency of the Prius. Cooke misinterpreted this statement [12]; the ESTEC platform matches the peak engine efficiency of the Prius (38%), not the average cycle efficiency of the Prius.

A.2 Novation's Simplistic Methodology and Lack of Rigor

This section is largely a restatement of A.1 with some added editorial that, again, incorrectly states the study methodology [1, page A-3] and mimics David Cooke's statement noted earlier:

"*... the Novation report assumes that no innovation will occur - no new technology will be implemented - in the eleven years until MY2025...*"

As shown earlier, the statement is incorrect. Further, EPA states [1, page A-2]:

"The methodology within the report is to survey the MY2014 fleet, grouping vehicles into broad "technology bundles" according to their powertrain. Within each bundle, the underlying technology was assumed to be identical, and any differences among powertrains attributed solely to "learning and implementation improvements." For example, one "bundle" is defined as an SI naturally aspirated engine coupled with a non-high ratio spread transmission, without stop-start. This bundle presumably includes vehicles with Atkinson cycle engines or cylinder deactivation, yet ascribes any efficiency gains due to the advanced technology to "learning.""

The vehicle packages studied were those used in the FRM as that was the overall objective of the study, not an evaluation of all technologies. The FRM represents a foundation for the MY 2022 through 2025 standards and, regardless of any new information published by EPA, the standards were established using specific vehicle and powertrain package assumptions reported in the FRM. It is the sustainability of these packages that Novation was requested to study, not alternative powertrain technologies that EPA may now be evaluating.

Novation's assessment of the technologies used in the FRM are detailed on pages 35 through 46 of the report [2]. Powertrain summaries of this information are provided in Tables VI through XI [2] and clearly state that these are from the results of the EPA and NHTSA studies. Any lack of detail was due, in large part, to lack of detail provided in the FRM. For example, EPA's LPM has no inputs for engine displacement, engine boost pressure, or engine compression ratio. Furthermore, key powertrain components, such as transmissions, were bundled into broad categories by EPA.

The LPM, on which most of Novation's analysis was focused, describes powertrains by broad technology packages. Consequently, Novation could only study the powertrain technology combinations as defined by EPA. In the Proposed Determination, EPA continues the practice of defining powertrains as broad technology packages; hence, by criticizing Novation, EPA is calling into question its own approach.

EPA goes on to pontificate about other technologies such as variable compression engines [1, page A-3]:

"*Moreover, the artificial limitation on innovation imposed in the Novation report completely discounts the effect of further innovation in the industry (such as, for example, Nissan's production-ready variable compression ratio engine, available in 2018), which may provide further cost-effective reductions in GHG emissions and fuel consumption. The Novation report assumes that new technologies like these (and others already announced by manufacturers to be utilized on future products), along with the fuel consumption benefits derived from them, would be impossible to incorporate in the future fleet.*"

Again, these technologies were not in the FRM. Nor are they included by EPA in the TAR or Proposed Determination. Therefore, Novation did not study them. Had they been in the FRM, Novation would have included them in the study.

Finally, regarding the use of diesel powertrains as a starting point for developing advanced spark-ignition powertrain maps, EPA states [1, page A-3]:

"No technical rationale for this choice is provided, and the report again relies on circular reasoning by using the argument that "it is unlikely even an advanced SI package will exceed the current CI efficiency boundary" to support the choice of using current CI powertrain efficiencies as a proxy for 27 bar SI engine powertrain efficiencies"

Novation did explain their technical rationale in the report [2, page 23]. While the combustion process is different (compression-ignition versus spark-ignition), the key attributes that allow diesel engines to achieve higher efficiencies than current spark-ignition engines are lower pumping losses, higher compression ratios, and dilute operation. These are the same benefits that EPA was claiming for the direct-injected, dilute, and highly boosted engines that served as the foundation of the FRM and, therefore, the MY 2022 through 2025 standards. Consequently, starting from the best diesel powertrain maps, and making adjustments for spark-ignition realities (e.g., lower compression ratios) provides a sustainable foundation for projecting the performance of these future powertrains.

A.3 Omission of Vehicle Load and Technology Penetration Rate Changes

Again, EPA misrepresents Novation's methodology and objectives; to evaluate the sustainability of the FRM powertrain effectiveness assumptions, not the vehicle load assumptions. The Novation study assumed the same mass, aerodynamic drag, and tire rolling resistance reductions as assumed by the agencies in the FRM and transposed those assumptions into the tractive energy domain [2, pages 15-19].

Related statements were made by David Cooke [8] regarding vehicle load, and these statements are also incorrect:

"The study largely ignores opportunities for reducing fuel usage beyond the engine, with lightweight materials being a particular oversight since the technology is already being deployed with levels of improvement exceeding those assumed by the study"

Furthermore, EPA attempts to discredit the Novation studies by suggesting that alternative powertrain pathways would have altered the assumptions for reduction in mass, aerodynamic drag, and tire rolling resistance [1, page A4]:

"*In an alternative world where powertrain technology cost-effectiveness is different, the EPA would revise its modeling and likely project a different mix of technologies in future fleets, as the cost effectiveness of each technology would likely change in comparison to the others.*"

However, in both the TAR and Proposed Determination documents, EPA uses the same, generic, assumptions for these parameters as it did in the FRM. Again, by criticizing Novation, EPA is calling into question its own assumptions.

A.4 Arbitrary and Restrictive Assumptions and Constraints

This section largely makes the same, baseless assumption that Novation limited technology growth [1, page A-4]:

"In addition to arbitrarily limiting technological progress to combinations existing in the fleet in MY2014, this Novation report likewise depends throughout on arbitrary assumptions and constraints which are largely unexplained, lacking in technical foundation, or unsupported by scientific rationale."

Novation made no such assumptions regarding technological progress. The second Novation report was largely a plausibility evaluation of the vehicle-level modeling results [3]. Contrary to EPA's assertions, the methodology was not arbitrary and was explained beginning on page 20 of the report.

Notably, EPA states [1, page A-4]:

"*calculation of powertrain efficiency can serve as a gross QC check on estimated technology effectiveness by quickly identifying the highest efficiency packages for further review*"

This is precisely what the second Novation study accomplished. For example, the Novation plausibility checks show individual vehicle simulations from the FRM that had cycle average efficiencies that were higher than the peak engine efficiency of the best engine maps used in the FRM, which is an impossible outcome.

While EPA is critical of the Novation's plausibility checks it offers no hard data or alternative and instead relies on an illustrative example of an engine map that is not from an actual, tested engine. Furthermore, the technology assumed from this map was not included in the TAR or the Proposed Determination.

Assumptions and constraints were established by Novation when there was a lack of information published by EPA, which has been resistant to providing support for these studies. An April 28, 2015 e-mail from Michael R. Olechiw (Director, Light-duty Vehicles and Small Engines Center, US EPA) to Greg Pannone (President, Novation Analytics) states:

"With regard to Mike Reale's continued requests for information regarding LD GHG Phase 1, I am going to instruct my team to ignore all of his requests. We have repeatedly told Mike that he should reference the Phase 1 information but he disregards our instructions. If you would like to discuss this matter directly, feel free to call me."

A copy of this e-mail is available upon request. Mike Reale was one of the principal investigators on the Novation studies. The reason for the repeated requests was that the Phase 1 information publicly available was not sufficient to fully examine the results. The requests were simply seeking disaggregated LPM model results.

EPA continues to criticize the Novation report without basis [1, page A-4]:

"... the assumptions used to estimate plausibility limits are unduly conservative and not at all optimistic. In fact, the Union of Concerned Scientists identifies at least one current production vehicle, a Honda Fit, which would be deemed implausible by the Novation report methodology."

Again, EPA relied on David Cooke for input rather than to confer with the authors of the Novation reports. David Cooke's assertion that the Honda Fit would be implausible by the Novation assessment is also incorrect [8]:

"Finally, in a show of just how arbitrary the constraints imposed by the study were, a number of vehicles already on the road today would be considered "implausible" according to their metrics, including the Honda Fit. When the study can't even properly capture the vehicles of today, how can it possibly be trusted to assess the vehicles of tomorrow?"

Novation would not deem the Honda Fit implausible. The MY 2016 Fit is within the best 1% of SI-based powertrains, having a combined efficiency of 25.5%; yet, it is 12% below the stated plausibility limits established by Novation Analytics [3, page 23].

Relative to EPA's assessment of on-cycle-to-peak engine efficiency [1, page A-6]:

"Since the Novation report develops a plausibility limit for on-cycle-to-peak engine efficiency ratio based on a few MY2013-2014 vehicles, no room is left for potential improvement in the efficiency matching; this is yet another example of the Novation report using an overly restrictive initial assumption to dismiss potential technological improvement."

Again, EPA did not correctly state the Novation assumptions. On the contrary, Novation assumed future improvements to on-cycle-to-peak engine efficiency ratios of 19% on the city cycle, 10% on the highway cycle, yielding 15% combined [3, page 28].

Every quality control process must provide limits beyond which action should be taken. Yet, despite its critique of Novation, EPA developed no alternatives; rather EPA simply stated in the Proposed Determination [1, section 2.3.3.5] that the modeling results were acceptable.

A.5 Displacement Specific Load and Exemplars

EPA agreed with Novation regarding this topic [1, page A-6]:

"The EPA agrees that "displacement-specific load" is an important parameter in determining technology effectiveness."

However, it again misrepresents Novation's assessments [1, page A-6]:

"However, both the Alliance and their contractor, Novation, fundamentally misunderstand the purpose and usage of the LPM."

Novation did not misunderstand the reason for the LPM. Novation describes the agency modeling processes and replicates the agencies' zero-dimensional modeling results [3, pages 13-19]. In summary, the LPM is a simplified model of incremental fuel consumption and CO_2 effectiveness (a simple Microsoft Excel spreadsheet) that provides the processing speed required to support the OMEGA model [1, chapter 5]. If simplicity and speed were not the issue, then EPA's ALPHA model would have been used to generate CO_2 values for the OMEGA model, rather than injecting the extra modeling step and the overhead associated with supporting and calibrating a second model.

A.6 Other Studies

Despite EPA's attempt to connect the two studies, John Thomas' study was conducted independent of Novation's work. Thomas and Pannone are advisory panel members for the fueleconomy.gov website, which is administered by Oak Ridge National Laboratory, and collaborate on a regular basis, as is common in the industry.

Regardless of any connection to Novation, John Thomas' technical paper was peer reviewed, as are all publications by SAE International.

EPA goes on to state [1, A7]:

"In fact, the methodology in the Thomas paper is essentially identical to that in the Novation reports, and Thomas states in his paper that the work "was inspired and focused by many discussions with Gregg (sic) Pannone, Novation Analytics.""

The methodology used by Novation and John Thomas has been independently reported by other research [13, 14, 15, 16, 17, 18]. Consequently, to suggest that this approach is without merit is to suggest that these other authors and peer reviewers were also incorrect.

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[3] Novation Analytics, "Technology Effectiveness – Phase II: Vehicle-Level Assessment (version 1.0)", September 20, 2016.

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[5] United States Environmental Protection Agency and National Highway Traffic Safety Administration, "2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standard," Federal Register, Volume 77, October 15, 2012.

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[17] Hochgraf, C. and Duoba, M., "What if the Prius Wasn't a Hybrid? What if the Corolla Were? An Analysis Based on Vehicle Limited Fuel Consumption and Powertrain and Braking Efficiency," SAE Technical Paper 2010-01-0834, 2010, doi:10.4271/2010-01-0834.

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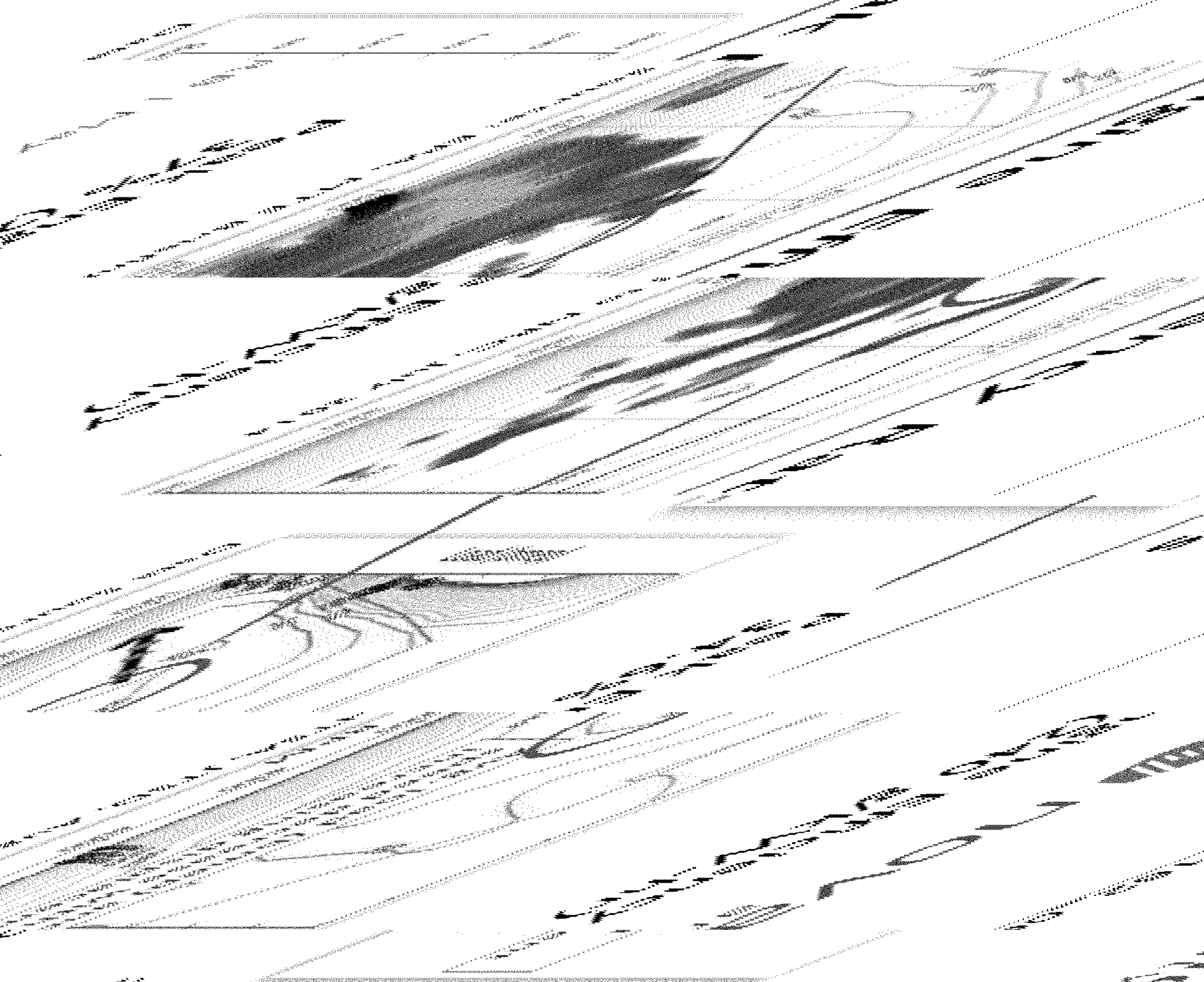

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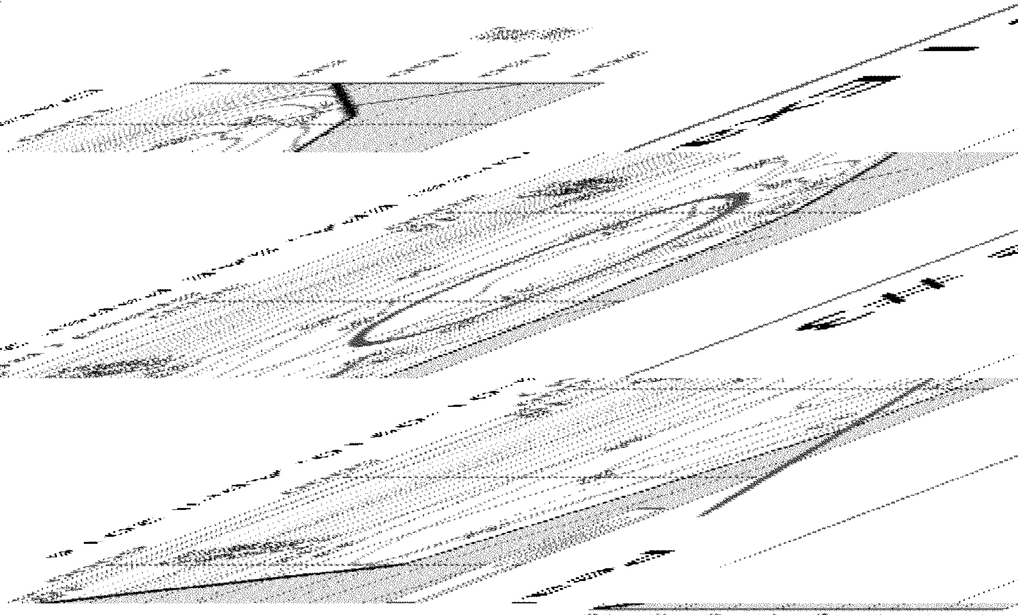

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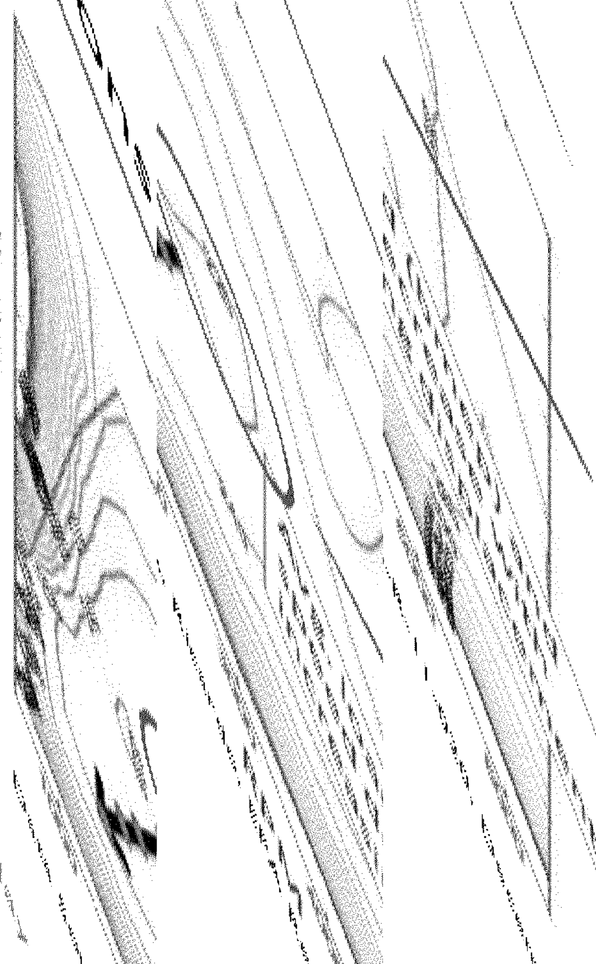

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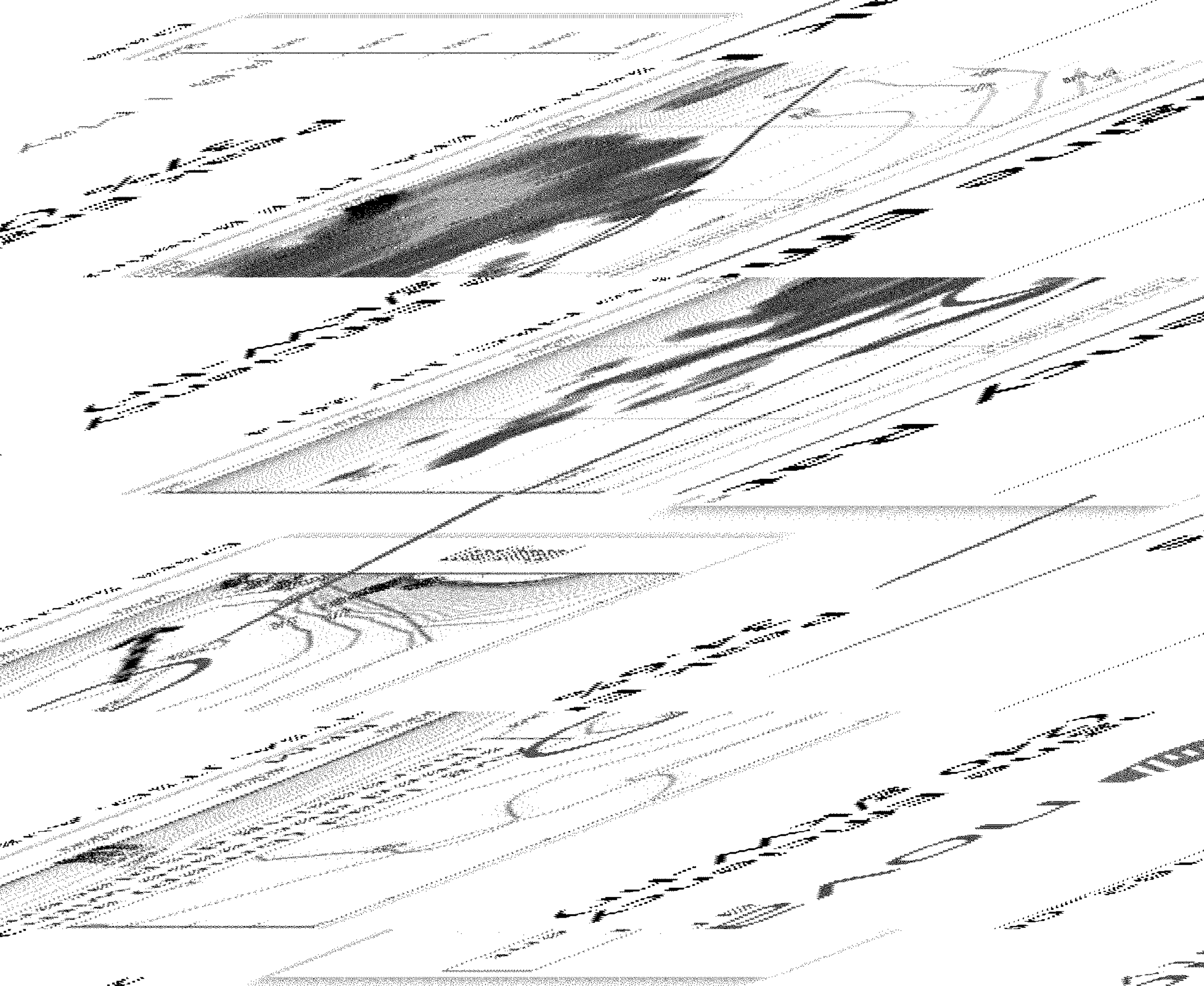

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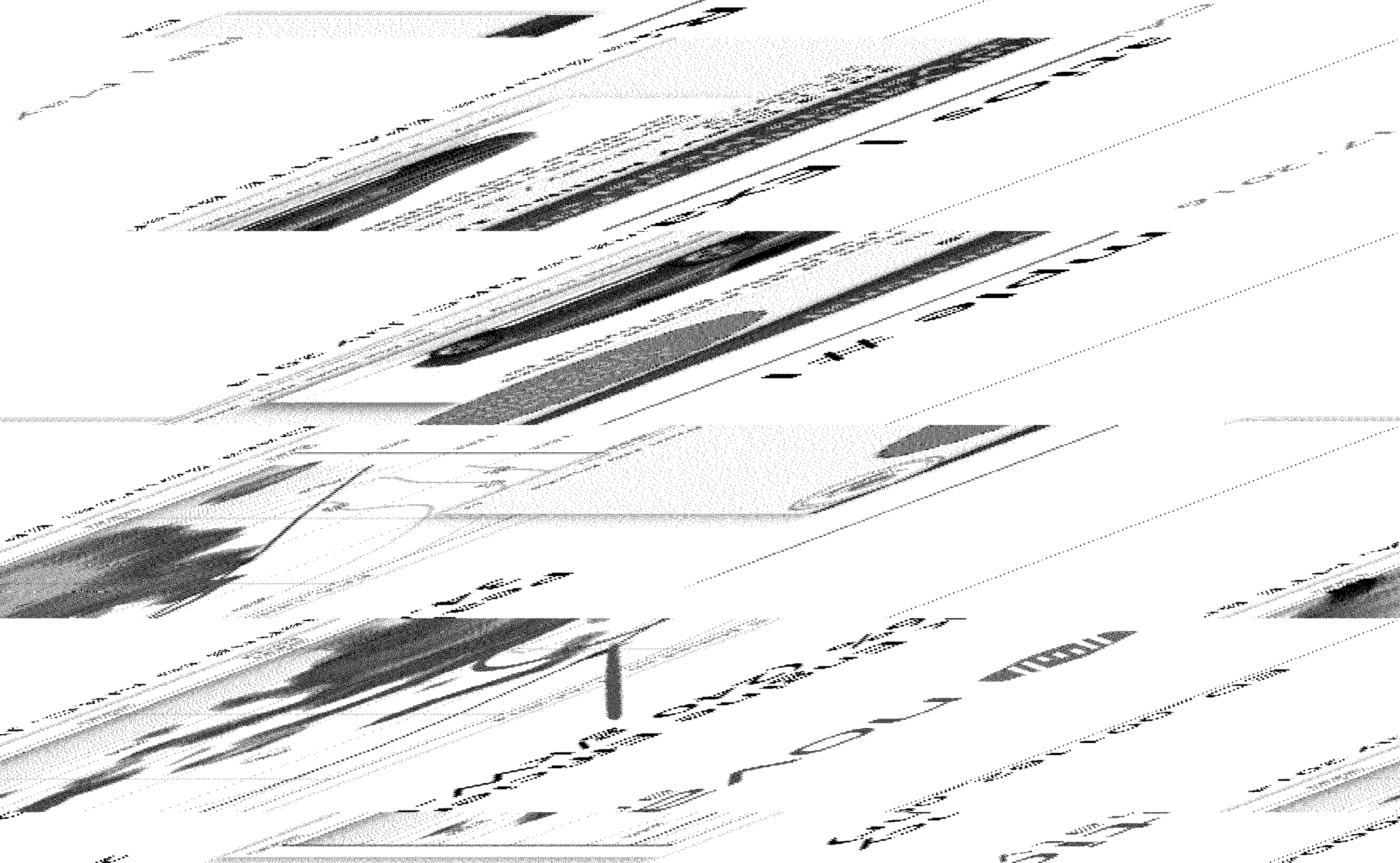

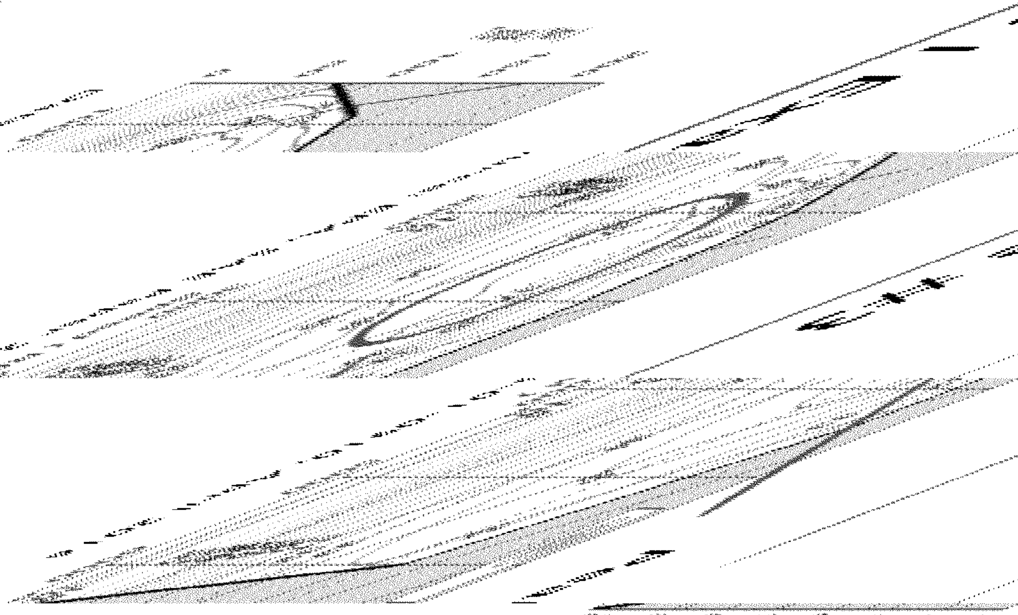

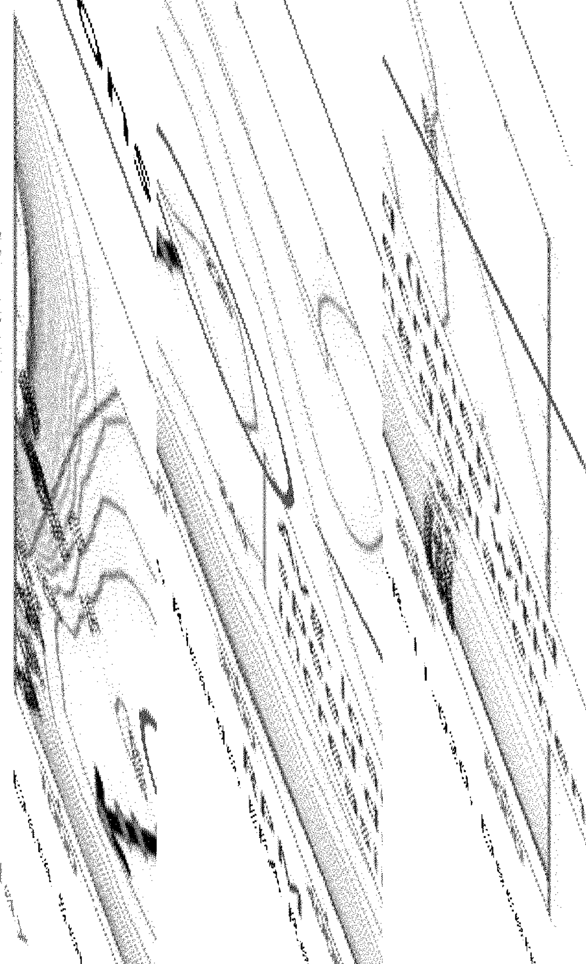

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To: John German[john@theicct.org]
Cc: Moran, Robin[moran.robin@epa.gov]
From: Bolon, Kevin
Sent: Mon 9/19/2016 10:15:07 PM
Subject: RE: 9/22 Hearing

See my definitions in red below.

-Kevin

From: John German [mailto:john@theicct.org]
Sent: Monday, September 19, 2016 2:54 PM
To: Bolon, Kevin <Bolon.Kevin@epa.gov>
Cc: Moran, Robin <moran.robin@epa.gov>
Subject: Re: 9/22 Hearing

Following is the list of acronyms that I don't understand:

ASL1 – Aggressive shift logic, level 1 (for the TAR, this is assumed to incorporated in the baseline fleet TRX11 and above)

ASL2 – Aggressive shift logic, level 2 (for the TAR, this is assumed to incorporated in the baseline fleet TRX11 and above)

EFR1 – Engine friction reduction, level 1

EFR2 – Engine friction reduction, level 2

HEG (although its zero) – High Efficiency Gearbox (HEG1 is assumed for TRX11 and TRX21, HEG2 is assumed for TRX12 and TRX22)

IACC1 – Improved Accessories, level 1

IACC2 – Improved Accessories, level 2

LDB – Low drag brakes

LRRT1 – Low rolling resistance tires, level 1

LRRT2 – Low rolling resistance tires, level 2

LUB – Low friction lubricants

REEV - I assume this is range-extended PHEV. However, I didn't see anything for regular PHEVs. – Range extended electric vehicle, synonymous with PHEV

SAX – Secondary axle disconnect for 4WD/AWD vehicles

SAX-NA – Indicator that SAX is not applicable in the case of FWD/RWD vehicles

TORQ (although its zero) Early torque converter lockup (for the TAR, this is assumed to incorporated in the baseline fleet TRX11 and above)

TRX11 – current gen 6spd ATs, CVTs

TRX12 – improved efficiency 6spd ATs

TRX21 – current gen wide ratio spread (i.e. 7+spd ATs), improved efficiency CVTs

TRX22 – improved efficiency wide ratio spread (i.e. 7+spd ATs) Also, while I know the various TRX refer to transmissions, do they distinguish between DCT and conventional automatic?

WRnet – net mass reduction, accounting for mass reduction penalty (WRnet = WRtech – WRpen), relative to 0% MR of null tech package (note that baseline vehicles may have some MR already applied)

WRpen – mass reduction penalty (additional mass for electrified powertrain: battery, motor etc.)

WRtech – mass reduction technology level applied, relative to 0% MR of null tech package

On Sep 19, 2016, at 2:01 PM, Bolon, Kevin <Bolon.Kevin@epa.gov> wrote:

Full hybrids in our analysis do use an Atkinson cycle, but a low compression ratio type such as the one used in the current Prius (thus the distinction between ATK1 for low CR, and ATK2 for high CR). The summary I provided does include MHEVs in the tech pens for IC engine technologies, but since ATK1 is not shown, HEVs are not included in tech pens for IC engines technologies (although the more detailed breakdown of tech pens that I attached in that earlier Excel file does show ATK1 tech pens).

Acronyms were defined as they were discussed in the text of the TAR, but there is no consolidated list of technology acronyms. For the most part, they should be self-explanatory, but obviously there are cases (like above) where it's not. If you have a few specific acronym that you would like some further explanation, please let me know.

-Kevin

From: John German [mailto:john@theicct.org]
Sent: Monday, September 19, 2016 1:30 PM
To: Bolon, Kevin <Bolon.Kevin@epa.gov>
Cc: Moran, Robin <moran.robin@epa.gov>
Subject: Re: 9/22 Hearing

Thanks, Kevin. Answer on Miler cycle makes sense - but less so on the balance of vehicles. Full and mild HEVs are still primarily dependent on ICE for propulsion. Your summary should include the engines used in hybrid applications.

Also, could you point me towards a list of definitions for all the of acronyms in your 4 worksheets?

John

On Sep 19, 2016, at 12:28 PM, Bolon, Kevin <Bolon.Kevin@epa.gov> wrote:

About 8% of the balance of vehicles have strong electrification (3%HEV, 2%PHEV, 3%EV). The remaining 10% or so of vehicles have some mild hybridization, although I don't have the exact proportion readily available since that MHEV technology is also present on some of the ATK2 and TDS vehicles. Between ATK2, TDS, MHEV, PHEV, and EV, it's going to be close to or equal to 100% of the fleet.

You had another question about the 4% penetration of Miller cycle, and why it was so low. The short answer is that, unlike TDS24, there is no engine downsizing assumed with the addition of Miller cycle. So although there is a substantial effectiveness benefit, the costs are higher than TDS24 because there's no potential to drop cylinders from I4→I3/V6→I4/V6→V8.

I hope that helps,

Kevin

From: John German [mailto:john@theicct.org]
Sent: Saturday, September 17, 2016 5:32 PM
To: Bolon, Kevin <Bolon.Kevin@epa.gov>
Cc: Moran, Robin <moran.robin@epa.gov>
Subject: Re: 9/22 Hearing

Sorry, I do have another question.

When I add up the various turbo and Atkinson percentages, I don't get anywhere close to 100%, i.e. 37% turbo, 44% Atkinson, or 81% total. What are the rest?

John

On Sep 16, 2016, at 7:10 PM, John German <john@theicct.org> wrote:

Hopefully I will have no more questions, Kevin. Thanks again for all your help.

John

On Sep 16, 2016, at 6:01 PM, Bolon, Kevin <Bolon.Kevin@epa.gov> wrote:

We didn't apply any additional restrictions to Miller cycle, beyond the relatively high (75%) penetration caps that are applied to TDS24, so your question about the relatively low penetration is a good one. My initial thought is that, like mass reduction penetrations, it really just illustrates how manufacturers have a number of cost effective options for compliance, but let me do a little more investigating to see if there were any other factors.

Ex. 6 - Personal Privacy

-Kevin

From: John German [mailto:john@theicct.org]
Sent: Friday, September 16, 2016 4:17 PM
To: Bolon, Kevin <Bolon.Kevin@epa.gov>
Cc: Moran, Robin <moran.robin@epa.gov>
Subject: Re: 9/22 Hearing

Exactly. :)

You only applied Miller cycle to 4% of the 2025 fleet? Why so conservative? The first applications are already in production and the turbo suppliers tell us that everyone is headed this way.

John

On Sep 16, 2016, at 3:56 PM, Bolon, Kevin <Bolon.Kevin@epa.gov> wrote:

We did include Miller cycle, which is represented in the tech pen table that I provided as 'TURBM'. We referenced the engine map published by VW on their 2016 2.0L EA888 engine in the TAR, and technology was applied to 4% of the 2025 fleet in our OMEGA analysis.

We also included variable geometry turbo; our estimates for TDS24 cost and effectiveness are based on the assumption that this technology is employed.

We did not explicitly model e-boost, VCR, or dynamic cylinder deactivation. Nor did we model HCCI, water injected turbos, or 48V MHEVs with a P2 configuration, although we do discuss the state of all of these technologies in the TAR write up. I think that remember hearing you mention before that EPA's analyses tend to be inherently conservative because we model only those technologies that we have a high degree of certainty in. It's obviously critical that we have a robust, defensible analysis, while at the same time, in response to criticism that we are overly optimistic, it seems fair for you to note in your testimony that we have not included these potentially promising future technologies, and of course there may be other technology innovations that are unforeseen.

- Kevin

From: John German [mailto:john@theicct.org]
Sent: Friday, September 16, 2016 2:42 PM
To: Bolon, Kevin <Bolon.Kevin@epa.gov>
Cc: Moran, Robin <moran.robin@epa.gov>
Subject: Re: 9/22 Hearing

Thanks, Kevin.

What about some of the technologies that are just now starting to enter production? Specifically, did the TAR include or evaluate any of the following technologies:

- Miller cycle (for turbos)
- E-boost (48v)
- Variable Compression Ratio

- VGT (variable geometry turbo) for gasoline engines
- Dynamic cylinder deactivation (i.e. deactivating individual cylinders every other stroke)

John

On Sep 16, 2016, at 10:46 AM, Bolon, Kevin <Bolon.Kevin@epa.gov> wrote:

Yes, there were multiple updates to cost and efficiency.

Focusing on EPA's analysis here, in addition to the newly added and very important ATK2 and 48V MHEV technologies mentioned below, here are some of the other highlights:

- Updated mass reduction costs, based on 4 independent teardown studies (Venza, Accord, 2011 and 2014 Silverado's), which at lower levels of mass reduction produced lower costs than the FRM estimates. Some of these cost savings were not available in our analysis with an updated baseline fleet, which we estimated had on average 2%MR relative to our 0% point on the cost curve.

- Increased effectiveness of future 8-speed transmissions (referred to as TRX22 in the TAR), as informed by benchmarking of multiple transmissions, published reports of future planned improvements by ZF, and results from our physics-based Alpha model.

- A significant reduction in battery cost estimates for the TAR for EVs and PHEVs as a result of updated battery and motor sizing estimates, and the application of DOE's latest version of the BatPaC model.

- Improved on-cycle effectiveness estimates for stop-start, based on more recent implementations of the technology

Not all of the changes from the FRM were in the direction of lower costs and higher effectiveness. Specifically:

- lowered effectiveness estimate for cylinder deactivation, based on our benchmarking of the Silverado V6 Ecotec engine

- costs for TDS24 are higher due to the additional costs of a variable geometry turbocharger with was not accounted for in the FRM.

I may have left out a few of the differences from the FRM, but those are the main ones. And for all the technologies, costs have been updated using 2013$, and an updated learning rate.

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Cc: Moran, Robin[moran.robin@epa.gov]
From: Bolon, Kevin
Sent: Mon 9/19/2016 6:01:47 PM
Subject: RE: 9/22 Hearing

Full hybrids in our analysis do use an Atkinson cycle, but a low compression ratio type such as the one used in the current Prius (thus the distinction between ATK1 for low CR, and ATK2 for high CR). The summary I provided does include MHEVs in the tech pens for IC engine technologies, but since ATK1 is not shown, HEVs are not included in tech pens for IC engines technologies (although the more detailed breakdown of tech pens that I attached in that earlier Excel file does show ATK1 tech pens).

Acronyms were defined as they were discussed in the text of the TAR, but there is no consolidated list of technology acronyms. For the most part, they should be self-explanatory, but obviously there are cases (like above) where it's not. If you have a few specific acronym that you would like some further explanation, please let me know.

-Kevin

From: John German [mailto:john@theicct.org]
Sent: Monday, September 19, 2016 1:30 PM
To: Bolon, Kevin <Bolon.Kevin@epa.gov>
Cc: Moran, Robin <moran.robin@epa.gov>
Subject: Re: 9/22 Hearing

Thanks, Kevin. Answer on Miler cycle makes sense - but less so on the balance of vehicles. Full and mild HEVs are still primarily dependent on ICE for propulsion. Your summary should include the engines used in hybrid applications.

Also, could you point me towards a list of definitions for all the of acronyms in your 4 worksheets?

John

On Sep 19, 2016, at 12:28 PM, Bolon, Kevin <Bolon.Kevin@epa.gov> wrote:

About 8% of the balance of vehicles have strong electrification (3%HEV, 2%PHEV, 3%EV). The remaining 10% or so of vehicles have some mild hybridization, although I don't have the exact proportion readily available since that MHEV technology is also present on some of the ATK2 and TDS vehicles. Between ATK2, TDS, MHEV, PHEV, and EV, it's going to be close to or equal to 100% of the fleet.

You had another question about the 4% penetration of Miller cycle, and why it was so low. The short answer is that, unlike TDS24, there is no engine downsizing assumed with the addition of Miller cycle. So although there is a substantial effectiveness benefit, the costs are higher than TDS24 because there's no potential to drop cylinders from I4→I3/V6→I4/V6→V8.

I hope that helps,

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Sorry, I do have another question.

When I add up the various turbo and Atkinson percentages, I don't get anywhere close to 100%, i.e. 37% turbo, 44% Atkinson, or 81% total. What are the rest?

John

On Sep 16, 2016, at 7:10 PM, John German <john@theicct.org> wrote:

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On Sep 16, 2016, at 6:01 PM, Bolon, Kevin <Bolon.Kevin@epa.gov> wrote:

We didn't apply any additional restrictions to Miller cycle, beyond the relatively high (75%) penetration caps that are applied to TDS24, so your question about the relatively low penetration is a good one. My initial thought is that, like mass reduction penetrations, it really just illustrates how manufacturers have a number of cost effective options for compliance, but let me do a little more investigating to see if there were any other factors.

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From: Bolon, Kevin
Sent: Fri 9/16/2016 7:56:11 PM
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We did include Miller cycle, which is represented in the tech pen table that I provided as 'TURBM'. We referenced the engine map published by VW on their 2016 2.0L EA888 engine in the TAR, and technology was applied to 4% of the 2025 fleet in our OMEGA analysis.

We also included variable geometry turbo; our estimates for TDS24 cost and effectiveness are based on the assumption that this technology is employed.

We did not explicitly model e-boost, VCR, or dynamic cylinder deactivation. Nor did we model HCCI, water injected turbos, or 48V MHEVs with a P2 configuration, although we do discuss the state of all of these technologies in the TAR write up. I think that remember hearing you mention before that EPA's analyses tend to be inherently conservative because we model only those technologies that we have a high degree of certainty in. It's obviously critical that we have a robust, defensible analysis, while at the same time, in response to criticism that we are overly optimistic, it seems fair for you to note in your testimony that we have not included these potentially promising future technologies, and of course there may be other technology innovations that are unforeseen.

- Kevin

From: John German [mailto:john@theicct.org]
Sent: Friday, September 16, 2016 2:42 PM
To: Bolon, Kevin <Bolon.Kevin@epa.gov>
Cc: Moran, Robin <moran.robin@epa.gov>
Subject: Re: 9/22 Hearing

Thanks, Kevin.

What about some of the technologies that are just now starting to enter production? Specifically, did the TAR include or evaluate any of the following technologies:

- Miller cycle (for turbos)

- E-boost (48v)
- Variable Compression Ratio
- VGT (variable geometry turbo) for gasoline engines
- Dynamic cylinder deactivation (i.e. deactivating individual cylinders every other stroke)

John

On Sep 16, 2016, at 10:46 AM, Bolon, Kevin <Bolon.Kevin@epa.gov> wrote:

Yes, there were multiple updates to cost and efficiency.

Focusing on EPA's analysis here, in addition to the newly added and very important ATK2 and 48V MHEV technologies mentioned below, here are some of the other highlights:

- Updated mass reduction costs, based on 4 independent teardown studies (Venza, Accord, 2011 and 2014 Silverado's), which at lower levels of mass reduction produced lower costs than the FRM estimates. Some of these cost savings were not available in our analysis with an updated baseline fleet, which we estimated had on average 2%MR relative to our 0% point on the cost curve.

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From: Bolon, Kevin
Sent: Tue 7/26/2016 1:34:14 PM
Subject: FW: Presentation
Novation_Analytics_Trade_Association_Technical_Briefing_CARB_17may2016_v1.0.key.pdf

From: McCarthy, Mike@ARB [mailto:michael.mccarthy@arb.ca.gov]
Sent: Wednesday, May 18, 2016 11:07 AM
To: Olechiw, Michael <olechiw.michael@epa.gov>; Bolon, Kevin <Bolon.Kevin@epa.gov>; james.tamm@dot.gov
Cc: Moran, Robin <moran.robin@epa.gov>; Barba, Daniel <Barba.Daniel@epa.gov>; Kevin.Green@dot.gov
Subject: FW: Presentation

FYI—share among your teams as needed.

This is the presentation that Global/Alliance delivered yesterday (Novation Analytics work). The meeting did NOT cover the cost study in process by C.A.R.—apparently that isn't done yet.

There are a couple of conclusion and recommendation slides at the very end of the attached deck if you want to skip to the punchline but their findings include:

-given the agency's estimates of road load reductions, the technologies the agencies said would get you to the stds fall short

-given the agency's estimates of road load reductions, there are no technologies in the agencies suite of technologies that can plausibly meet the stds short of significant electrification (one of their scenarios that might get there was 5% n.a., ~80% a futured (by Novation) downsized turbo with high ratio spread trans and stop-start, and ~15% strong hybrid)

-the methodology of using LPM or a look-up table of results to adjust the results before feeding into OMEGA/VOLPE is flawed. The methodology is inaccurate compared to full vehicle simulation models and would need substantial improvements to make it work. As it is now, it produces many configurations with implausible results

-the full vehicle simulations used by the agencies (Ricardo, Autonomie, ALPHA) are wrong and produce implausible results of potential efficiency

Personally, I'm still digesting it all to comprehend the caveats and assumptions that are key in their analysis and it will take some time to unpack their suggested QA/QC metrics to identify plausible/non-plausible configurations.

By the way, one item worth noting might be that the Novation analytics does characterize the mazda SkyActiv at the leading edge of the gasoline powertrains out there, and Greg Pannone made a few comments about that technology posting some pretty good numbers. (But to be clear, in his metric of vehicle energy efficiency, the SkyActiv is around 26% relative to most gasoline cars around 22% and by his calculations, they need 30-32+% efficiencies from gasoline cars to get to the 2025 standards.) More to come from them I'm sure.

From: Greg Pannone [mailto:gpannone@novationanalytics.com]
Sent: Tuesday, May 17, 2016 2:17 PM
To: McCarthy, Mike@ARB
Subject: Presentation

Gregory Pannone | President

novation analytics

2851 High Meadow Circle, Suite 160

Auburn Hills, MI 48326

M 313.910.3280

novationanalytics.com

To: Grundler, Christopher[grundler.christopher@epa.gov]; Moran, Robin[moran.robin@epa.gov]
Cc: Charmley, William[charmley.william@epa.gov]; Olechiw, Michael[olechiw.michael@epa.gov]; Hengst, Benjamin[Hengst.Benjamin@epa.gov]
From: Bolon, Kevin
Sent: Mon 12/7/2015 11:09:55 PM
Subject: RE: Postponement of the NHTSA Workshop on Modeling Methodology for Draft TAR Analysis for CAFE Standards
EPA comments on 201510 ANL Vehicle modeling draft paper.docx

Chris,

All of the MTE tech team staff has spent some time today looking over the workshop materials that NHTSA sent to EPA on Friday. Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

I'm attaching a summary from EPA staff in both ASD and NCAT. With all the detailed comments it was a little hard to keep things concise, but the first two pages are intended for you to read. The main points are:

Ex. 5 - Deliberative Process

The complete original comments are in the appendix.

Kevin

From: Grundler, Christopher
Sent: Monday, December 07, 2015 5:21 PM
To: Moran, Robin
Cc: Charmley, William; Olechiw, Michael; Bolon, Kevin; Hengst, Benjamin
Subject: RE: Postponement of the NHTSA Workshop on Modeling Methodology for Draft TAR

Analysis for CAFE Standards

Thanks Robin

From: Moran, Robin
Sent: Monday, December 07, 2015 3:44 PM
To: Grundler, Christopher
Cc: Charmley, William; Olechiw, Michael; Bolon, Kevin; Hengst, Benjamin
Subject: FW: Postponement of the NHTSA Workshop on Modeling Methodology for Draft TAR Analysis for CAFE Standards

Chris,

Bill asked me to send this to you directly. NHTSA has officially postponed their modeling workshop until "early 2016". We received the public announcement below a couple hours ago.

Later this afternoon, Kevin Bolon will send you a write-up of our high level comments on the NHTSA workshop materials.

Robin

From: Rulemaking_correspon@dot.gov [mailto:Rulemaking_correspon@dot.gov]
Sent: Monday, December 07, 2015 12:40 PM
To: Rulemaking_correspon@dot.gov; Olechiw, Michael; michael.mccarthy@arb.ca.gov; Moran, Robin; Bolon, Kevin; Robert_Bienenfeld@ahm.honda.com; james_kliesch@ahm.honda.com; rick_gezelle@toyota.com; William_Chernicoff@toyota.com; RWimmer@tma.toyota.com; Prashant.ramashandra@tema.toyota.com; gary.oshnock@fcagroup.com; rajinder.dhatt@fcagroup.com; mengyang.zhang@fcagroup.com; nhomeist@ford.com; mjennin5@ford.com; pphlips@ford.com; barbara.kiss@gm.com; matthew.rudnick@gm.com; michael.o.harpster@gm.com; madhu.raghavan@gm.com; joseph.burgel@gm.com; yasumi.nakamura-newbraugh@Nissan-Usa.com; bryan.jacobs@bmwna.com; thomas.hofmann@bmwna.com; ALilly@hatci.com; dbakker@hatci.com; blee@hatci.com; ktachikawa@hra.com; ADAmbrosi@hatci.com; mbraishe@jaguarlandrover.com; cblair18@jaguarlandrover.com; pschofi3@jaguarlandrover.com; agardin2@jaguarlandrover.com; rwill226@jaguarlandrover.com; katherine.yehl@volvocars.com; jill.nikeus@volvocars.com; william.craven@mbusa.com; shaun.roopnarine@mbusa.com; R-

Thomas.Brunner@mbusa.com; felix.wellmann@daimler.com; john.tillman@daimler.com; dba1@subaru.com; DRobertson@mazdausa.com; jtakeda1@mazdausa.com; Stuart.Johnson@vw.com; Nick.Tamborra@vw.com; JHamilton@ucsusa.org; dcooke@ucsusa.org; TLanger@aceee.org; skhan@aceee.org; hilary@redmtngroup.com; jrege@globalautomakers.org; CNevers@autoalliance.org; Ltonachel@nrdc.org; jesse.prentice-dunn@sierraclub.org; john@theicct.org; Stacey.Bernards@Honeywell.com; pierre-jean.cancalon@honeywell.com; William.j.smith@honeywell.com; Ana.Meuwissen@us.bosch.com; gpannone@novationanalytics.com; cjfrance@sbcglobal.net; michael.mccarthy@arb.ca.gov; analisa.bevan@arb.ca.gov; mihaidorobantu@eaton.com; Michael.howenstein@allisontransmission.com; jacob.ward@ee.doe.gov; David.Anderson@ee.doe.gov; david.howell@ee.doe.gov; Sunita.Satyapal@ee.doe.gov; fred.joseck@ee.doe.gov; John.Maples@eia.gov; splotkin@anl.gov; tlanger@aceee.org; anup@theicct.org; john@theicct.org; francisco@theicct.org; dwhm@uw.edu; jeremy.michalek@gmail.com; wkcheng@mit.edu; dkeith@mit.edu; knittel@mit.edu; vkarplus@mit.edu; JHolmes@nas.edu; MOffutt@nas.edu; linn@rff.org; rubinj@maine.edu; DeCicco@umich.edu; Panagiota.dilara@ec.europa.eu; Georgios.fontaras@fcto.eu; biagio.ciuffo@jrc.ec.europa.eu; bert.witkamp@avere.org; gcullen@electricdrive.org; wuzhixin@catarc.ac.cn; jdean@kemco.or.kr; sl@acea.be; benoit.parmentier@mpsa.com; stephane.rimaux@mpsa.com; eric.chauvelier@renault.com; ludovic.raffier@renault.com; damien.maroteaux@renault.com; m-kubo@mail.nissan.co.jp; jshi@saicusa.com; ctennant@crcao.org; CHand@karmaautomotive.com; ZHE_HUANG@denso-diam.com
Cc: Rulemaking_correspon@dot.gov
Subject: Postponement of the NHTSA Workshop on Modeling Methodology for Draft TAR Analysis for CAFE Standards

Dear Stakeholder,

We regret to inform you that the NHTSA Workshop on Modeling Methodology for Draft TAR Analysis for CAFE Standards has been postponed until early 2016. We are working to identify a new date for the workshop and will inform stakeholders as soon as we have rescheduled it.

Below you will find the revised meeting notice.

Thank you,

NHTSA Rulemaking Office

****

The National Highway Traffic Safety Administration (NHTSA) is hosting a workshop on ~~December 14, 2015~~ (**TO BE DELAYED UNTIL JANUARY. DATE TO BE DETERMINED**) at the Department of Transportation (DOT) Headquarters for the purpose of sharing information on the Argonne National Laboratory (ANL) modeling methodology that is being used to inform the Corporate Average Fuel Economy (CAFE) analysis for the Draft Technical Assessment Report (TAR).

Background:

The Draft TAR analysis for CAFE standards will be informed by extensive modeling conducted by ANL using the Autonomie vehicle simulation tool to estimate the effects of combinations of technologies on fuel economy. Large-scale simulation is being conducted to simulate a majority of feasible technology combinations and will yield databases that are flexible, account for all technology interactions, and can be fed directly into the CAFE (Volpe) model, which NHTSA uses for fleet-level analysis. While the Autonomie model is used widely by industry, academia, researchers and the U.S. Government, the approach for the large-scale simulation has been presented publicly in a limited number of conferences. The workshop will provide opportunity to share information more widely. Some example model inputs and outputs will also be shared in the workshop.

For more information on the workshop and the CAFE program, please visit: http://www.nhtsa.gov/fuel-economy

The agency is posting a draft preliminary report on ANL's modeling methodology, example simulation inputs, and example results in advance to facilitate stakeholder discussions at the workshop. These materials, as well as background on the overall simulation modeling effort and NHTSA's MYs 2022-2025 CAFE rulemaking and midterm evaluation, will be available after 5:00 pm today at: http://www.nhtsa.gov/Laws+&+Regulations/CAFE+-+Fuel+Economy/ld-cafe-midterm-evaluation-2022-25

Workshop Details:

Date: ~~December 14, 2015~~ **TO BE DELAYED UNTIL JANUARY. DATE TO BE DETERMINED.**

Time: ~~12:00 pm to 5:00 pm~~ **TO BE DETERMINED**

Location: DOT Headquarters Conference Center, 1200 New Jersey Ave., SE, Washington, DC 20590

To allow sufficient time to be checked in and make it through security, NHTSA asks all attendees to arrive at least 30 minutes in advance of the workshop's start time.

Please RSVP by **TO BE DETERMINED** ~~December 12, 2015~~ by email to Rulemaking_correspondence@dot.gov,

For questions, call (202) 366-1810.

If interested parties are unable to attend in person, NHTSA is providing access via teleconference and web meeting. To join the meeting, please use the following information:

Audio: **TO BE DETERMINED**

~~USA Toll-Free: (877)848-7030~~

~~USA Caller Paid/International Toll: (404)443-2170~~

~~ACCESS CODE: 3660933~~

Video: **TO BE DETERMINED**

~~Web Conference URL: https://www.connectmeeting.att.com or https://www.webmeeting.att.com~~

~~Meeting Number(s): (877)848-7030 or (404)443-2170~~

~~Access Code: 3660933~~

To: Caffrey, Cheryl[caffrey.cheryl@epa.gov]
From: Lieske, Christopher
Sent: Thur 11/3/2016 6:44:11 PM
Subject: FW: FCA US LLC Comments to Draft Technical Assessment Report
FCA Comments to Draft TAR (CONFIDENTIAL-VERSION) 26-Sept-2016.pdf
FCA Comments to Draft TAR (PUBLIC-VERSION) 26-Sept-2016.pdf

From: Silverman, Steven
Sent: Monday, September 26, 2016 5:18 PM
To: Moran, Robin <moran.robin@epa.gov>; Lieske, Christopher <lieske.christopher@epa.gov>; Wysor, Tad <wysor.tad@epa.gov>
Subject: FW: FCA US LLC Comments to Draft Technical Assessment Report

Please see that these get docketed properly, and note that one of the files has CBI

From: Jones Kyle M (FCA) [mailto:kyle.m.jones@fcagroup.com]
Sent: Monday, September 26, 2016 4:57 PM
To: Silverman, Steven <silverman.steven@epa.gov>
Cc: Oshnock Gary (FCA) <gary.oshnock@fcagroup.com>
Subject: FCA US LLC Comments to Draft Technical Assessment Report

Mr. Silverman:

Attached are two pdf files representing FCA US LLC's comments to the draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025 ("TAR").

• The file marked "Confidential" is FCA's full confidential comments to the TAR, which contains FCA confidential business information ("CBI"), and must not be shared publically or posted to the public docket in any form. If there is any unclarity as to whether any page or pages contains

CBI, please consider each page to contain CBI and check with the undersigned with questions prior to any action being taken as to any public disclosure.

• The file marked "Public-Version" that is formatted to redact FCA's CBI; this version of the comments can be made public and can be posted to EPA's public document. Each area within this document where CBI has been redacted is viewed as "white space." Please consider any such page of the public version of FCA's comments with such redacting white space as containing CBI.

Please feel free to contact me at the address, email address or phone number below with questions, and especially prior to acting on a request received under the Freedom of Information Act. Thank you.

Kyle M.H. Jones

Senior Counsel

Environment, Health & Safety

Office of the General Counsel

FCA US LLC

1000 Chrysler Drive, CIMS 485-13-62

Auburn Hills, MI USA 48326-2766

(248) 512-4064

To: Charmley, William[charmley.william@epa.gov]
Cc: Olechiw, Michael[olechiw.michael@epa.gov]; Lieske, Christopher[lieske.christopher@epa.gov]
From: Moran, Robin
Sent: Fri 9/30/2016 9:01:37 PM
Subject: RE: Janet's request for TAR comments
Alliance_of_Automobile_Manufacturers.pdf
Consumers Union.pdf
UAW.PDF
ACEEE.pdf
UCS.pdf
NACAA.pdf
NADA.pdf

Bill,

To your question of whether we committed to send these to Janet. I'm not sure if we explicitly committed, but she did ask, and I don't see a reason not to.

Here are the comments that I think would be most interesting for Janet:

Alliance

UCS

ACEEE

UAW

Consumers Union

NACAA

NADA

Ex. 5 - Deliberative Process

From: Charmley, William

Sent: Thursday, September 29, 2016 4:52 PM
To: Moran, Robin <moran.robin@epa.gov>
Cc: Olechiw, Michael <olechiw.michael@epa.gov>; Lieske, Christopher <lieske.christopher@epa.gov>
Subject: RE: Janet's request for TAR comments

Robin –

I agree. Did we may a commitment to Janet that we would send her some of the comment this week?

Thanks

Bill

From: Moran, Robin
Sent: Thursday, September 29, 2016 4:36 PM
To: Charmley, William <charmley.william@epa.gov>
Cc: Olechiw, Michael <olechiw.michael@epa.gov>; Lieske, Christopher <lieske.christopher@epa.gov>
Subject: Janet's request for TAR comments

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

We could also send her this nice comment count summary that Chris pulled together:

Commenter Category	Number of Comments
Academic	5
Chambers of Commerce and Business Councils	2
Environmental NGOs	17
Federal Government	1
Fuels Industry	16
Other NGOs	11
State and Local Government	4
Technology Suppliers	17
Vehicle Dealers and Associations	1
Vehicle Manufacturers	12
Other Companies and Industries	1
Total Organization Comments	**87**

Total Comments Received: 211,700

Robin

Cc: Amandine Muskus[amuskus@globalautomakers.org]
From: Julia Rege
Sent: Mon 9/26/2016 9:46:02 PM
Subject: Comments on Draft TAR | Global Automakers
Global Automakers Comments on TAR w Appendices.pdf

Dear Colleagues,

Please find attached a copy of Global Automakers' comments submitted today on the Draft TAR; it has been placed in the EPA and NHTSA dockets, as well as emailed to ARB's specified link. We are happy to discuss these further at any point in time and look forward to continuing our work together.

Best, Julia

Julia Rege

Director, Environment & Energy

Association of Global Automakers, Inc. (Global Automakers)

1050 K Street, NW, Suite 650

Washington, DC 20001

202.650.5559 (direct)

202.650.5555 (main)

jrege@globalautomakers.org

GlobalAutomakers

To: Charmley, William[charmley.william@epa.gov]
From: John German
Sent: Tue 9/20/2016 2:43:18 PM
Subject: Fwd: Sept. 22 hearing on new FE standards
Calstart supplier survey CAFE 2025.pdf
ATT00001.htm

Just in case you haven't seen this, Bill.
John

Begin forwarded message:

From: Nic Lutsey <nic@theicct.org>
Subject: Re: Sept. 22 hearing on new FE standards
Date: September 16, 2016 at 11:53:43 AM EDT
To: John German <john@theicct.org>

Hi John,
It's perhaps worth a skim of the Calstart study (done by Ricardo, released this week) that used a Delphi-style confidential survey of suppliers to get their views of the 2025 standards. You can make the same points from what you know with you collaboration with suppliers, of course, but it might help strengthen your statements to mention stats (e.g., 2/3 of suppliers support standards, primarily to secure investments they've made, that you meet standards primarily with conventional technology, suppliers would like post 2025 target planning to start due to long development lead-times, etc).

Nic

September 26, 2016

Christopher Lieske
Office of Transportation and Air Quality
Assessment and Standards Division
Environmental Protection Agency

Rebecca Yoon
Office of Chief Counsel
National Highway Traffic Safety Administration

Michael McCarthy
Air Resources Board

Submitted electronically to www.regulations.gov and 2016TAR@arb.ca.gov.

Docket ID No. EPA-HQ-OAR-0827
Docket ID No. NHTSA-2016-0068
CARB – http://www.arb.ca.gov/msprog/levprog/leviii/2016tar.htm

Alliance of Automobile Manufacturs Comments on Draft Technical Assessment Report: Midterm Evaluation of Light-Dut y Greenhouse Gas Emission Standa rds and Corporate Average Fuel Economy Standards for Model Years 2022-2025 (EPA-420-D-16-900, July 2016)

Dear Mr. Lieske, Ms. Yoon, and Mr. McCarthy,

I am submitting the enclosed comments and associated attachment s on behalf of the Alliance of Automobile Manufacturers[1] (Alliance) in response to the subject Draft Technical Assessme nt Report.

The Alliance supports the One National Program (ONP) and its goals of reducing greenhouse gas (GHG) emissions and improving the corporate average fuel econom y (CAFE) of light-duty vehicles via harmonized federal and state regulations.

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[1] The Alliance of Automobile Manufacturers, is an association re presenting 12 manufacturers of cars and light trucks. Alliance members are BMW Group, FCA US LLC, Ford Motor Company, General Motors Company, Jaguar Land Rover, Mazda, Mercedes-Benz USA, Mitsubishi Motors, Porsch e Cars North America, Toyota, Volkswagen Group of America, and Volvo Car USA. For more information, please visit: www.autoalliance.org.

Your consideration of these comments and attachments is appreciated. If you have any questions on this matter, please contact me at (248) 357-4717, extension 103 or at MHartrick@autoalliance.org.

Sincerely,

Michael Hartrick

Michael Hartrick
Director of Fuel Economy & Climate
Alliance of Automobile Manufacturers

Table of Contents

List of Acronyms

0-D	zero dimensional
1-D	one dimensional
2010 FRM	2010 final rulemaking – 75 Fed. Reg. 25324 (May 7, 2010).
2012 FRM	2012 final rulemaking - 77 Fed. Reg. 62623 (Oct. 15, 2012).
2WD	two-wheel drive
4WD	four-wheel drive
AAA	American Automobile Association
AAPC	American Automotive Policy Council
Advanced Atkinson Tech Package	non-hybrid Atkinson engine with cooled EGR and cylinder deactivation
A/C	air conditioning
ADA	Americans with Disabilities Act
AHSS	advanced high strength steel
AEO	Annual Energy Outlook
Agencies	U.S. Environmental Protection Agency and National Highway Traffic Safety Administration
Alliance	Alliance of Automobile Manufacturers
ALPHA	EPA's Advanced Light-Duty Powertrain and Hybrid Analysis
ANL	Argonne National Laboratory
ATK2	Atkinson cycle engine in a non-hybrid application
AWD	all-wheel drive
BEV	battery electric vehicle
BISG	belt integrated starter generator
BIW	body-in-white
BMEP	brake mean effective pressure
BSFC	brake specific fuel consumption
CAA	Clean Air Act
CAFE	Corporate Average Fuel Economy
CAR	Center for Automotive Research
CARB	California Air Resources Board
C_d	coefficient of drag
C_dA	the product of the coefficient of drag and frontal area
CEC	California Energy Commission
CEGR	cooled exhaust gas recirculation

CISG	crank integrated starter generator
CNG	compressed natural gas
CO_2	carbon dioxide (interchanged with greenhouse gas in many cases)
COP	coefficient of performance
CR	compression ratio
CVT	continuously variable transmission
CVVL	continuously variable valve lift
cyl	cylinder
DC	direct current
DCT	dual clutch transmission
DEAC	cylinder deactivation
D/M	engine displacement to vehicle mass ratio
DMC	direct manufacturing cost
DOHC	dual overhead cam
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EER	effective expansion ratio
EGR	exhaust gas recirculation
EIA	United States Energy Information Administration
EMF	electromagnetic frequency
EPA	U.S. Environmental Protection Agency
Estimator	EPA's Vehicle Energy Effects Estimator tool
ETW	equivalent test weight
E.U.	European Union
EV	electric vehicle
EVDC	externally controlled variable displacement compressor
FARS	fatality analysis reporting system
FCV	fuel cell vehicle
FE	fuel economy
FWD	front wheel drive
GHG	greenhouse gas
GDI	gasoline direct injection
GDP	gross domestic product
Global Automakers	The Association of Global Automakers, Inc.
GREEN	Global Refrigerants Energy and Environmental
GTDI	gasoline turbocharged direct injection
GUI	graphical user interface

GWP	global warming potential
HEG2	high efficiency gearbox level 2
HEV	hybrid electric vehicle
IAV	IAV Automotive Engineering
ICE	internal combustion engine
IHX	internal heat exchanger
IMAC	improved mobile air conditioner
ISOR	initial statement of reasons
IU	Indiana University
KAPSARC	King Abdullah Petroleum Studies And Research Center
LCCP	Lifecycle Climate Change Performance
LHV	lower heating value
LIVC	late intake valve closing
LPCEGR	low pressure cooled exhaust gas recirculation
LPM	Lumped Parameter Model
LWV	Light-weight vehicle
MAC	mobile air conditioning
MDPV	medium-duty passenger vehicle
MBT	mean best torque
MTE	midterm evaluation
MUD	multi-unit dwelling
MY	model year
NA	naturally aspirated
NADA	National Automobile Dealers Association
NHTS	National Household Travel Survey
NHTSA	National Highway Traffic Safety Administration
NHTSA Base Engine Map	IAV Gasoline Engine1 Map as described at Draft TAR, p. 5-505
NRC	National Research Council
NVES	Strategic Vision's New Vehicle Experience Survey
NVH	noise-vibration-harshness
NPRM	notice of proposed rulemaking
NREL	National Renewable Energy Laboratory
OBD	on-board diagnostics
OEM	original equipment manufacturer
OLV	overlap volume
OMEGA	EPA's Optimization Model for reducing Emissions of Greenhouse gases for Automobiles

ONP	One National Program
ORNL	Oak Ridge National Laboratory
PEV	plug-in electric vehicle
PFI	port fuel injection
PHEV	plug-in hybrid electric vehicle
PM	particulate matter
R&D	research and development
REEV	range-extended electric vehicle
RIA	regulatory impact analysis
RON	research octane number
RPM	revolutions per minute
RWD	rear wheel drive
SAE	Society of Automotive Engineers
SLOOS	U.S. Federal Reserve Senior Loan Officer Opinion Survey
SOHC	single overhead cam
U.S.	United States (of America)
USCAR	United States Council for Automotive Research
variable CS valve	variable crankcase suction valve
VMT	vehicle miles travelled; also referred to as vehicle lifetime miles (VLM)
Volpe Model	CAFE Compliance and Effects Modeling System
V2G	vehicle to grid
V2V	vehicle to vehicle
VGI	vehicle to grid interface
VVL	variable valve lift
VVT	variable valve timing
W	watts
ZEV	zero emission vehicle
ZEV Mandate	13 CCR §§ 1962.1, 1962.2
ZEV Program	13 CCR §§ 1962.1, 1962.2

Attachments

Attachment1_Novation_Fleet_Level_Tech_Study

Attachement2_Novation_Vehicle_Level_Tech_Study

Attachment3_CAR_Powertrain_Study

Attachment4_CAR_Mass_Reduction_Study

Attachment5_Novation_Analytics_Briefing_May_2016

Attachment6_Joint_Alliance_Global_Petition_for_Rulemaking_2016-06-21

Attachment7_Limitations_of_Ricardo_Fuel_Economy_Analysis_of_Downsizing

Attachment8_EPA_ALPHA_Samples_Transmission_Walk

Attachment9_CAR_Barriers_to_Lightweighting

Attachment10_Novation_Analytics_MY2015_Baseline_Study

Attachment11_Fuel_Economy_Standards_and_Low_Income_Households

Introduction

In 2011, 13 light-duty vehicle manufacturers, including several Alliance members, submitted letters[2] to the U.S. Environmental Protection Agency (EPA) and National Highway Traffic Safety Administration (NHTSA) (collectively, Agencies) in support of the model year (MY) 2017-2025 ONP. A key reason those manufacturers were able to support standards[3] that would not be in effect until over a decade later was due to the Agencies' agreement to conduct a midterm evaluation (MTE) of those standards. The MTE is meant to reassess the practicability and feasibility of the MY2022-2025 standards by examining all relevant factors, including the availability, benefits, and costs of technology; factors related to customer acceptance; economic factors; and other related issues. [4] A proposed determination of the appropriateness of the GHG standards and notice of prosed rulemaking (NPRM) for the CAFE standards for MY2022-2025 is expected in 2017[5] and a final determination on the GHG standards must be made by April 2018, with a CAFE final rule to follow. [6] The Draft TAR is the first milestone in the MTE process. It forms the basis on which the proposed determination and NPRM will rely. As such, it is critically important that it be fact-based, accurate, and robust in its analysis.

The Draft TAR contains more than 1,200 pages and incorporates the findings of dozens of separate studies, most of which were not previously available. Recognizing the complexity of this analysis, on August 1, 2016, the Alliance submitted a request for an extension of the 60-day comment period.[7] The Agencies denied this request. Nonetheless, the 60-day comment period is not a sufficient amount of time to review and provide meaningful input on all of the complex technical analyses in the Draft TAR. The Alliance anticipates submitting supplemental comments after the close of the 60-day comment period, and expects that the Agencies will respond formally to those comments prior to issuing a proposed decision and NPRM to ensure that they include the most up-to-date information.[8]

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[2] "Transportation and Climate: Presidential Announcements and Stakeholder Commitment Letters." EPA. Accessed September 7, 2016. https://www3.epa.gov/otaq/climate/letters.htm#2011a1.
[3] The Alliance recognizes that the MY2022-2025 CAFE standards are considered "augural" and subject to a de novo rulemaking. For simplicity, these standards are herein referred to, at times, without noting their augural status.
[4] 40 CFR 86.1818-12(h) and 77 Fed. Reg. 62784 (Oct. 15, 2012).
[5] See https://www3.epa.gov/otaq/climate/mte.htm and http://www.nhtsa.gov/Laws+&+Regulations/CAFE+-+Fuel+Economy/ld-cafe-midterm-evaluation-2022-25. Accessed September 23, 2016)
[6] *Id.*
[7] Letter from Chris Nevers, Vice President, Environmental Affairs, The Alliance of Automobile Manufacturers to Chris Lieske, Environmental Protectio Agency, Rebecca Yoon, National Highway Traffic and Safety Administration, and Michael McCarthy, California Air Resources Board (August 1, 2016). Docket ID EPA-HQ-OAR-2015-0827-0928 and NHTSA-2016-0068-0022.
[8] Letter from Julia Rege, Director, Environment and Energy, The Association of Global Automakers, Inc., and Chris Nevers, Vice President, Environmental Affairs, The Alliance of Automobile Manufacturers to Janet McCabe, Acting Assistant Administrator for the Office of Air and Radiation, US Environmental Protection Agency and Paul

The Alliance has significant concerns with much of the data and analyses in the Draft TAR. Our key concerns fall into two areas. The first is a fundamental disagreement with the level of technologies modeled by the Agencies as likely required for manufacturers to comply with the future standards. Simply stated, there are numerous flaws in the modeling, and additional (and more costly) technology will be needed than suggested by the Draft TAR. The second concern is that the Agencies have not adequately met their obligation to assess customer acceptance of those technologies that will be necessary for future compliance. These concerns are interrelated: if flawed modeling projects the cost of compliance incorrectly low, then customer acceptance, willingness, and/or ability to pay for such efficiency improvements will be lower than projected. In particular, customer willingness to pay for efficiency is further hampered by the dramatic decrease in fuel prices since the 2012 final rulemaking (2012 FRM).[9] This directly threatens both the ability of manufacturers to comply with the standards and the overall success of the program.

In addition, experience with the ONP has demonstrated two other concerns, implicit in the Draft TAR, which must be addressed. First, "one" national program has not resulted in harmonizing the three underlying programs of EPA, NHTSA and the California Air Resources Board (CARB). Second, flexibilities and other necessary regulatory elements are crucial to compliance and the success of the program.

The following comments and ten appendices address these concerns, and a number of other issues.

Agency Modeling Underestimates Actual Technologies Required

To predict GHG and CAFE compliance (and associated costs) five to eight model years in the future, the Agencies use various modeling techniques to identify potentially available technologies and to assess their effectiveness, cost, and impacts across the entire light-duty vehicle fleet. The Alliance has identified numerous issues with these techniques that must be addressed before going forward with the proposed determination and NPRM. In essence, the Agencies' fleet level modeling results do not match independent analyses of the technologies which will be required to meet future GHG and CAFE targets. These analyses predict more electrification will be required (including full hybrids) than either Agency predicts. There are several reasons for the differences in modeling outputs, including the Agencies' overestimation of technology effectiveness.

Hemmersbaugh, Chief Counsel, National Highway Traffic Safety Administration (Sept. 9, 2016). Docket ID EPA-HQ-OAR-2015-0827-3292.

[9] "2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards," 77 Fed. Reg. 62623 at 62624 (Oct. 15, 2012).

Specific comments on the Agencies' vehicle technology package simulation modeling can be found in Appendix A, and comments on specific vehicle technologies in Appendix B. These appendices address the overarching concern that the Agencies appear to have minimized real-world constraints and have selected only the most optimistic data available for the purposes of evaluating technology costs, effectiveness, and leadtime.

Agency Modeling Outputs Do Not Match Third-Party Analyses

Third-party modeling outputs, both at the vehicle and fleet level, do not match either Agency's projections. The resulting conclusion from these third-party studies is that more technology will be needed than projected in the 2012 FRM. The Agencies' modeling methods overestimate the effectiveness of technologies at the vehicle level and over-project the vehicle level benefits to the fleet.

The Alliance consulted Novation Analytics (who also provided the Vehicle Load Reduction analyses attached as Appendix A to the Draft TAR) for their assessment of the Agencies' 2012 FRM technology pathway modeling. Novation Analytics provided a study[10] (Fleet Level Tech Study, attached as Attachment 1) which includes today's fleet with the latest, most advanced fuel efficient technologies noted by the Agencies as effective through 2025. This study examined the feasibility of achieving the energy conversion efficiencies implied by the MY2021 and MY2025 GHG and CAFE targets using the Agencies' projected technology mix.[11] The results of the study, shared with the Agencies and CARB, show that the MY2021 and MY2025 targets cannot be met with the suite of technologies at the deployment rates projected by the Agencies in the 2012 FRM. It concludes that more technology will be needed than predicted by the Agencies. Essentially, only vehicles as efficient as modern strong hybrids will meet those future targets and "conventional" powertrains will likely not displace the need for more electrification.

Oak Ridge National Laboratory (ORNL) reached similar conclusions in a recent publication.[12] ORNL concluded that "[t]he path to meeting 2025 standards will likely involve significantly larger numbers of hybrid electric powertrain vehicles and/or plug-in vehicles being sold, compared to the current U.S. sales of such vehicles." and "[i]t will be quite difficult for the most efficient gasoline vehicles to reach 29%-31% combined-cycle efficiency, but this is the level the gasoline fleet would need to average to comply with the 2025 regulations…"

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[10] "Technology Effectiveness – Phase 1: Fleet-Level Assessment." Novation Analytics. 2015.
[11] The Fleet Level Technology Study assumed all agency-projected mass, aerodynamic, and tire load reductions. It also accounted for learning and agency assumptions of credits.
[12] Thomas, J., "Vehicle Efficiency and Tractive Work: Rate of Change for the Past Decade and Accelerated Progress Required for U.S. Fuel Economy and CO_2 Regulations," *SAE Int. J. Fuels Lubr.* 9(1):2016, doi:10.4271/2016-01-0909.

Novation Analytics was subsequently consulted to investigate potential vehicle level sources of the issues identified in the Fleet Level Tech Study. The resulting study on vehicle level technologies (Vehicle Level Tech Study, attached as Attachment 2) identified Agency modeling process issues as the key source of error in technology benefit estimates.[13] This study identified a number of issues with the Agencies' modeling processes including:[14]

1. Some of the full vehicle simulation results used to calibrate technology effectiveness models are over-optimistic and fail basic, and very liberal, plausibility checks… the model assumptions do not properly account for implementation issues such as durability and reliability requirements, emissions and on-board diagnostics (OBD) compliance, and consumer needs such as drivability and noise-vibration-harshness (NVH) limits.
2. The [EPA Lumped Parameter Model] used to project the incremental effectiveness of technologies (applied to each manufacturer's vehicle models) are not based on the fundamental factors determining vehicle CO_2 and fuel consumption and thus fail to adequately capture the efficiency trends and relationships which influence the incremental benefit of added technology.
3. The [A]gencies' modeling processes do not recognize the inherent variability of efficiency within the light-duty fleet, treating all products within a category as equal… this approach results in over-projection of the most efficient vehicles.
4. No procedure or methodology is currently in place to check the outcomes of the technology effectiveness projection process against logical efficiency metrics and limits. Without such checks, the outcomes can exceed plausible limits.
5. **The combination of these sources of error – overoptimistic vehicle simulation results used to calibrate an oversimplified technology effectiveness projection process —compound and yield overoptimistic vehicle-level and ultimately fleet-level results.** (Emphasis added.)

In summary, the Vehicle Level Tech Study shows that the Agencies' modeling processes, particularly the EPA's Lumped Parameter Model (LPM), have systemic issues that need to be corrected to obtain accurate results.

To better ascertain fleet plausibility in MY2022-2025, the Agencies should move to full vehicle simulation with quality and plausibility checks. If EPA retains the LPM, it should be updated to reflect proper powertrain principles and its outputs should be validated against actual vehicles and full vehicle simulations which were not used to calibrate the LPM.

[13] "Technology Effectiveness – Phase II: Vehicle-Level Assessment." Novation Analytics. 2016.
[14] *Id.* at 8 et seq.

The 60-day comment period was not enough time to make a thorough analysis of all the modeling and to engage the Agencies in the sustained manner needed to resolve all the modeling issues before submitting our comments on the Draft TAR. The Alliance looks forward to working with the Agencies to address these and other modeling issues. We believe that the Agencies could hold public workshops to reassess and remedy the findings and recommendations identified in the Draft TAR and specifically in Chapter 5. The workshops could emphasize resolving issues in an iterative manner together with automakers and other experts, adding workshop days as needed, instead of the format using a presentation followed by questions and answers.

Technology Effectiveness and Cost

The core of the Agencies' technology assessments are the analyses located in Chapter 5 of the Draft TAR. The Alliance provides comments in Appendix B on some of the key technologies modeled by the Agencies such as advanced Atkinson cycle engines, gasoline downsized turbocharged direct injection (GTDI) engines, transmission technologies, mild hybrids, P2 versus power split hybrids, mass reduction, aerodynamic improvement, and tire rolling resistance reduction. Due to the limited time made available to comment on the Draft TAR, the Alliance focused its efforts on what were considered key technologies, but notes that the Agencies should not interpret a lack of comment on any specific area as assent.

The analysis includes the following key findings:

1. Advanced Atkinson Cycle Engines: EPA combines an Atkinson cycle engine (based on the Mazda SkyActiv engine) with cooled exhaust gas recirculation (CEGR) and cylinder deactivation, claiming large synergistic benefits, and applies the technology to 40% of the modeled MY2025 fleet. The Alliance identified multiple technical errors resulting in over-optimistic projections of benefit. In addition, we note that Mazda, other automakers, and EPA have not been able to verify the modeled benefits because this technology package could not be fully operated, even in a laboratory setting.
2. Downsized GTDI Engines: The Agencies' model inputs were based on high octane fuel and no consideration was given to customer acceptance when determining the degree of downsizing.
3. Transmission Technologies: The effectiveness modeled by the Agencies exceeds that demonstrated by manufacturers using the technologies described. Furthermore, EPA's grouping of transmission technologies ignores the unique effectiveness and cost implications of these vastly different technologies.
4. Mild Hybrids: The Agencies' cost and benefits estimates are inconsistent and should be revisited. In addition, projected costs failed to include those associated with vehicle integration.

5. Strong Hybrids: The Draft TAR assigns identical cost and effectiveness values to both Power-Split and P2 hybrids. The architectures of these two technologies are sufficiently different to warrant separate assessments.
6. Mass Reduction: Modeling of mass reduction in a continuous fashion instead of discrete bins yields incorrect benefit assumptions. Theoretical mass reductions do not properly account for materials already in use.
7. Aerodynamic Improvements: Aerodynamic improvements are too broadly applied, resulting in implausible levels of aerodynamic reduction for many vehicles.
8. Tire Rolling Resistance: Further consideration must be given to the degree of rolling resistance reduction applied to specific vehicles.

Individually and collectively, these issues will result in overestimation of the benefits of the technologies modeled, and subsequently result in underestimating the overall penetrations of technology to meet the MY2022-2025 standards (and resulting costs).

The Alliance makes the following recommendations to improve Chapter 5:

1. Full vehicle simulation modeling should be used to assess CO_2 and fuel economy (FE) performance. That is, the Lumped Parameter Model should be retired.
2. The advanced Atkinson technology package with CEGR and cylinder deactivation should not be utilized in the MTE analysis until the technology can be demonstrated to operate across all modeled operating points.
3. The Agencies should incorporate and make readily available modeling quality control parameters.
4. The GTDI packages should be revaluated for high load operation and other constraints while operating on 91 research octane number (RON) market and certification test fuels.
5. Vehicle performance metrics should be harmonized across both Agencies.
6. The EPA high efficiency transmission gear box (HEG2) package should not be utilized in modeling until it can be demonstrated as feasible.
7. The Agencies should study appropriate limits for reductions in tire rolling resistance related to customer acceptance.
8. Due to the various issues manufacturers face with implementing CEGR and cylinder deactivation, both Agencies should further explain and document the assumptions used in simulating related loss and electrical load functions.
9. The negative fuel economy and CO_2 impacts associated with Tier 3 emissions should be included in the analysis.
10. The negative fuel economy and CO_2 impacts associated with the California 1 milligram-per-mile particulate matter standard should be taken into account.
11. The Agencies should harmonize vehicle electrical loads.

Due to time constraints, the Alliance did not assess the fleet level costs of compliance described in the Draft TAR (or underlying assumptions such as learning and indirect costs), but did sponsor studies by the Center for Automotive Research (CAR) to assess the cost and effectiveness of powertrain technologies and the costs and challenges to reducing mass.

The CAR Powertrain Study (attached as Attachment 3),[15] gathered actual cost data for powertrain technologies and pathways directly from manufacturers. The manufacturers' aggregated average direct manufacturing costs (DMC), when compared to NHTSA's cost estimates, show that most DMCs are, in general, higher than NHTSA's costs from the 2012 FRM. Given the trend shown in the study, even neglecting the predicted need for more technology than the Agencies estimated, the Alliance expects the Agencies' under-estimation of technology costs have continued in the Draft TAR. The CAR Powertrain Study indicates the cost of compliance to the MY 2022-2025 targets will be higher than the Agencies projected for two reasons: more technology is needed than projected; and, in general, manufacturer costs for most technologies are higher than estimated by the Agencies.

The CAR Mass Reduction Study (attached as Attachment 4)[16] gathered vehicle content information and mass reduction pathways from nine manufacturers and vehicles representing almost half of U.S. sales. Comparing the CAR work to the Draft TAR, some general conclusions can be made, including the need for the Agencies to reassess the cost of mass reduction. Based on the updated EDAG Engineering GmbH cost study,[17] the Alliance believes that the Agencies' final mass reduction cost curves should be updated, and likely increased, based on evolution of the baseline fleet, barriers to mass reduction implementation, mass added to meet future market and regulatory requirements, and the manufacturers' challenges in fully applying secondary mass reductions."

Baseline Technology Assessment

Perhaps the most critical step in modeling the technologies (and costs) required to bring the future fleet into compliance with the MY2022-2025 standards is an accurate evaluation of the technologies already in use on current vehicles. This ensures that the projected future level of technology applied to meet the standards is feasible and practicable, and that the costs of such future technology are appropriately taken into account.

There are several issues in the Agencies' development of the baseline fleets that will result in significant errors and inconsistencies. For instance, the Agencies used two different baseline years (MY2014 for EPA and MY2015 for NHTSA). There are also errors in the baseline mass

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[15] "An Assessment of Powertrain Technology Costs Associated with Meeting CAFE and GHG Standards." Center for Automotive Research. 2016. Attached as Attachment3_CAR_Powertrain_Study.
[16] "Assessing the Fleet-wide Material Technology and Costs to Lightweight Vehicles." Center for Automotive Research. 2016. Attached as Attachment4_CAR_Mass_Reduction_Study.
[17] Singh, H., Kan, C-D., Marzougui, D., & Quong, S. (2016, February). "Update to future midsize lightweight vehicle findings in response to manufacturer review and IIHS small-overlap testing" (Report No. DOT HS 812 237). Washington, DC: National Highway Traffic Safety Administration.

reduction, including the degree of technology already implemented, and a failure to apply the analysis to individual vehicles. In addition, there are major problems in the baseline aerodynamic drag assessment. A number of smaller problems also exist in the analysis, including assumptions about baseline tire rolling resistance. All of these issues and other baseline-related matters are extensively discussed in Appendix C.

Customer Acceptance Concerns

There is no question that manufacturers are capable of developing and producing products that meet the MY2022-2025 standards. However, the success of the program depends on customer purchase of those products, not the mere ability to produce them. The Draft TAR projects far less technology, particularly less electrification, than will be necessary, and hence the Agencies posit less cost than will be necessary. This error has a direct influence on the analysis of customers' ability (and willingness) to purchase new vehicles.

Although customers value fuel economy, they consider a wide range of other factors when making new vehicle purchasing decisions. Among these are cost, affordability, comfort with new technology, seating capacity, handling, tow and load capability, safety, and comfort. Rather than asking whether the auto industry can build a vehicle that achieves MY2025 compliance, the Agencies should be asking whether the auto industry will be able to sell a fleet of vehicles that meet these future targets.

In the 2012 FRM, the Agencies indicated that an analysis of customer acceptance would be vital to the assessment of whether the MY2022-2025 standards are appropriate. Notwithstanding the central importance of this issue, under 30 pages of the 1,200-page Draft TAR are dedicated to an evaluation of customer acceptance. After providing a cursory literature review, the Agencies conclude that they cannot make any significant conclusions. They point to positive statements from professional auto reviewers without even attempting to link such statements to actual purchasing behaviors. The Alliance respectfully submits that this topic requires more extensive and robust study than a review of enthusiast or consumer magazines.

Indeed, other organizations have recognized the need for serious research on customer acceptance. For instance, the National Research Council's 2015 report on fuel economy technologies for light-duty vehicles[18] contains three separate recommendations for further research by the Agencies, including "research on the existence and extent of the energy paradox

[18] "Cost, Effectiveness and Deployment of Fuel Economy Technologies for Light-Duty Vehicles." National Academy of Sciences, National Research Council to the National Academies. 2015.

in fuel economy, the reasons for customers' undervaluation of fuel economy relative to its discounted present value, and differences in customers' perceptions across the population."[19]

It is no answer to this lack of serious research to assert that manufacturers have had a history of over-compliance with the standards for the early model years. While 22% of MY2015 vehicles operating on diesel or gasoline meet the MY2018 standards or can do so with air conditioning improvements, fewer than 4% of current vehicles can meet the MY 2022 targets, and no diesel or non-hybrid gasoline models meet the MY2025 target. While the Agencies contend that these out-year standards do not require significant hybridization or electrification, this conclusion exceeds current technology realities.

The Fleet Level Tech Study [20] further illustrates this disconnect. Novation Analytics found that automakers will need to apply additional and costlier technologies than were initially predicted to meet the projected MY2021 and MY2025 targets, and that the post-MY2021 standards cannot be achieved without significantly higher sales of advanced technology vehicles, including hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), and battery electric vehicles (BEVs) (also known collectively plug-in electric vehicles or PEVs). Novation Analytics concludes, "[m]oving the entire industry to the current best spark-ignition powertrains would provide compliance only to MY 2020. Advanced [spark ignition] SI technologies, unproven in production, and/or high rates of electrification will be required by MY 2025."[21]

Hybridization and electrification raise costs and, to date, customers have not demonstrated a willingness to purchase such vehicles in large numbers. One reason is the current low state of gasoline prices. The 2012 FRM was developed with an expectation of structurally high gas prices but is unfolding in a period of sustained low gas prices, profoundly impacting customer choice. In the Agencies' original analysis of the 2017-2025 joint rule, they predicted gas prices would be $3.87 in 2010 dollars by 2025, or about $5 a gallon. This assumption was made when fuel prices were at their highest level in the past 40 years, exceeding those of the late 1970s and early 1980s.[22] The fuel market has shifted quite dramatically since the 2012 FRM. Earlier this month, the American Automobile Association (AAA) national average fuel price was $2.22 and in August, gas prices in 14 states were below $2.00 per gallon. [23] While various uncertainties have the potential to disrupt the world oil market, in its *2015 Annual Energy Outlook*, the U.S. Energy Information Adminsitration (EIA) projects gas prices to remain relatively low through

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[19] *Id.*, pp. 333-334.
[20] "Technology Effectiveness – Phase 1: Fleet-Level Assessment." Novation Analytics. 2015.
[21] "Trade Association Studies; Powertrain Technology Effectiveness, Phase II." Novation Analytics. Technical Briefing. May 17, 2016. Accessed September 21, 2016. Attached as Attachment 5.
[22] "Short-Term Energy Outlook." U.S. Energy Information Administration. Accessed September 21, 2016. http://www.eia.gov/forecasts/steo/realprices/.
[23] "AAA Gas Prices." American Automobile Association. Accessed September 21, 2016. http://gasprices.aaa.com/.

2030.[24] Such low gas prices have resulted in a disconnect between customer preferences and the future CAFE/GHG standards. The 2012 FRM projected the 2025 vehicle fleet to be comprised of 67% passenger cars and 33% trucks. However, the Agencies' updated assessment in the Draft TAR now projects that the fleet mix in 2025 will likely be 52% cars and 48% trucks– acknowledging the direct impact low gas prices have on the composition of the vehicle. When gas prices fall, especially in the context of improving mileage across segments of the market, the desire to walk out of the showroom with a hybrid (or other alternative powertrain) diminishes.

The customer acceptance challenges of meeting the MY2022-2025 standards are real and need more sophisticated analysis in the final TAR and upcoming NPRM. To perform an appropriate cost-benefit analysis, the Agencies must address the matters discussed above as well as the following issues (each of which is discussed in greater detail in Appendix E):

- The enormous disparity between the payback periods anticipated by the Agencies and those that customers will tolerate raises important questions regarding long-term viability of the new car market.
- Automakers have limited tools with which to drive customer acceptance despite significant efforts to promote and incentivize highly efficient vehicles.
- Growth in the sales of highly efficient vehicles has been limited by low gasoline prices, the satisfaction customers already express with current fuel economy levels via modern internal combustion engines, and the fact that fuel economy savings are reduced as miles-per-gallon increase.
- Positive third-party reviews often do not translate to higher sales, particularly for electric powertrain vehicles.
- Increasing costs have an effect on affordability, and this issue needs further analysis, especially if the current, low-interest financing era ends.
- Cost increases resulting from a steep increase in fuel-efficiency requirements are likely to reduce the overall demand for new vehicles and constrain employment throughout the automotive sector.

Because of the importance of customer acceptance, the Alliance has done an extensive analysis of the matter, concluding that compliance with the MY2022-2025 standards will require a much higher and earlier deployment of more expensive technologies, with far higher levels of electrification than suggested in the Draft TAR. As a result, those levels and costs are far higher than customers are currently prepared to accept (See Appendix E).

[24] "Annual Energy Outlook 2015." U.S. Energy Information Administration. Accessed September 21, 2016. https://www.eia.gov/forecasts/archive/aeo15/.

Harmonization Issues

NHTSA and EPA Harmonization

On June 20, 2016, the Alliance and The Association of Global Automakers, Inc. (Global Automakers)[25] submitted a petition [26] (see Attachment 6) asking EPA and NHTSA to make several regulatory changes to better harmonize their respective regulations for GHGs and fuel economy. The issues raised in this petition are relevant for the MTE because of their many interactions with the assessments of the MTE. In addition, there are other differences between the EPA, NHTSA and CARB programs subsumed in the ONP. First, there is an inconsistency in the technical assessments performed by EPA and NHTSA. Second, and more significantly, the Draft TAR completely fails to harmonize with CARB's Zero Emission Vehicle (ZEV) Program ("ZEV Program" or "ZEV mandate")[27] by ignoring the costs of the ZEV mandate.

The Draft TAR Fails to Account for Costs and Technologies Needed to Comply with the ZEV Mandate

For the first time, EPA has included the estimated volumes of plug-in electrified and fuel cell vehicles that automakers are expected to produce under the ZEV mandate. The ZEV mandate, as adopted by California and nine other states, will effectively force specific GHG reducing solutions (heavy electrification) into the market rather than allowing the "technology-agnostic" approach previously advocated by EPA and NHTSA. Because EPA waived the ZEV Program under the Clean Air Act, it is now wholly appropriate that EPA include the effect of the ZEV mandate when projecting technology pathways and costs for EPA's own national GHG program.

California's ZEV Mandate creates $6 billion in costs

When calculating the costs of the GHG program, EPA builds into its reference fleet the benefits of 280,300 fully electric, plug-in and hydrogen fuel-cell vehicles that manufacturers are expected to produce in response to the ZEV Program. However, EPA does not take into account the cost of the ZEV Program in California and the other ZEV states – regions of the country which also fall under the requirements of the federal GHG and FE standards. Economists working for CARB estimate that vehicles produced in response to the ZEV mandate will cost customers between $7,500 and $15,000 more in MY2025 as compared to today's average vehicle prices.[28]

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[25] Global Automakers' members are Aston Martin, Ferrari, Honda, Hyundai, Isuzu, Kia, Maserati, McLaren, Nissan, Subaru, Suzuki, and Toyota. Please visit www.globalautomakers.org for further information.
[26] Letter from C. Nevers to Mark Rosekind, PhD and Gina McCarthy re: Petition for Direct Final Rule with Regard to Various Aspects of the Corporate Average Fuel Economy Program and the Greenhouse Gas Program (June 20, 2016).
[27] 13 CCR §§ 1962.1 and 1962.2
[28] "Staff Report: Initial Statement Of Reasons, Advanced Clean Cars, 2012 Proposed Amendments To The California Zero Emission Vehicle Program Regulations." California Environmental Protection Agency, Air

They also estimate that by MY2025, compliance with the ZEV Program in California alone will cost automobile manufacturers more than $6 billion annually.[29]

EPA's failure to consider the costs of the ZEV mandate would conflict with its own guidance and could result in arbitrary decision-making, for several reasons. First and fundamentally, the integrity of cost-benefit analysis requires making equivalent assumptions on both the cost and benefit sides of the analysis. Specifically, if the EPA assesses the *benefits* that the ZEV mandate will contribute to achieving the MY2022-2025 standards, the *costs* of that mandate should also be considered. Otherwise, the cost assessment will understate the true costs to manufacturers for achieving the future standards. This is particularly important where the costs of the ZEV mandate are large enough to effectively dictate a particular pathway for achieving compliance at costs that can materially affect the feasibility of achieving the CAFE and GHG standards. Alternatively, were the Agencies to disregard the costs of the ZEV mandate, the costs of compliance with the MY2022-2025 standards should be spread over only the incremental benefits of emissions reductions *beyond* the ZEV mandate. Still this would be a less useful approach, since accounting for all of the costs and benefits better positions the Agencies to consider the feasibility of the standards.

Second, EPA has explained in its guidance the position that it is generally appropriate to include existing regulations in the cost baseline because, presumably, those costs have been accounted for elsewhere and should not be counted twice.[30] However, EPA has not considered the cost of the ZEV program at any point in time.[31] Indeed, CARB has not considered the full costs of

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Resources Board. 2011. 64. Accessed September 21, 2016. https://www.arb.ca.gov/regact/2012/zev2012/zevisor.pdf.

[29] "Staff Report: Initial Statement Of Reasons, Advanced Clean Cars, 2012 Proposed Amendments To The California Zero Emission Vehicle Program Regulations." California Environmental Protection Agency, Air Resources Board. 2011. Table 5.6. Accessed September 21, 2016. https://www.arb.ca.gov/regact/2012/zev2012/zevisor.pdf.

[30] See National Center for Environmental Economics, Office of Policy, U.S. Environmental Protection Agency, "Guidelines for Preparing Economic Analyses" (December 17, 2010) at 5-9. Cited authority states "[i]f a proposed regulation is expected to increase compliance with a previous rule, the correct measure of the costs and benefits generally excludes impacts associated with the increased compliance. This is because the costs and benefits of the previous rule were presumably estimated in the economic analysis for that rule, and should not be counted again for the proposed rule."

[31] In evaluating whether to grant California the waiver necessary to implement the ZEV mandate, EPA did not fully evaluate the costs of the mandate at that time, either. Instead, EPA largely deferred to CARB estimates. See, e.g., U.S. Environmental Protection Agency, "Notice of Decision Granting a Waiver of Clean Air Act Preemption for California's Advanced Clean Car Program and a Within the Scope Confirmation for California's Zero Emission Vehicle Amendments for 2017 and Earlier Model Years," 78 Fed. Reg. 2111, 2115 (Jan. 9, 2013), noting that in the waiver context, EPA gives "very substantial deference to California's judgment" on the balancing of costs and benefits, and 78 Fed. Reg. 2118, noting that in decision whether to grant a waiver, EPA "provide[s] California with the broadest possible discretion in setting regulations that it finds protective of the public health and welfare while limiting EPA's review to a narrow role that provides substantial deference to the State."

compliance with the ZEV mandate, including the other states that have adopted the ZEV mandate. Omitting the costs of measures that would play a substantial role in achieving compliance with the MY2022-2025 standards would thus run counter to the objectives of transparency and sound decision-making that underlie the Agencies' cost-benefit analysis.

In summary, the Alliance believes that EPA should include the cost of the ZEV Program in the TAR, especially since the ZEV mandate provides no net GHG benefit and could force a more expensive compliance pathway than might otherwise be taken.

The Alliance also notes that NHTSA does not build ZEV compliance into its baseline scenario. A sensitivity analysis of EPA modeling that includes NHTSA's assumptions in this regard is critical for a realistic assessment of costs and benefits of the GHG program. For further discussion of these matters, see Appendix H.

NHTSA and EPA Performed Separate Technical Assessments

EPA and NHTSA have conducted separate technical assessments that the Agencies then combined into a single Draft TAR. In the Draft TAR's executive summary, the Agencies conclude that their "independent analyses complement one another and reach similar conclusions."[32] Considering their different statutory mandates, different approaches to defining baselines, and variations between the models used, some variation in outcomes is, of course, to be somewhat expected. However, the breadth of disagreement between the Agencies on several key modeling outcomes leads one to ask whether these outcomes really do "complement one another." For example, the percentage of higher compression ratio, naturally aspirated gasoline engines automakers are expected to deploy to meet the MY2025 standards differs by 43%. Similarly, the percent of turbocharged and downsized gasoline engines differs by 21%, and the percent of stop-start technology differs by 18%.[33] While some of these disparities are explainable, the delta between the Agencies' modeling outcomes implies that they are actually in significant *disagreement* as to how automobile manufacturers could comply with the standards, leading one to question their joint conclusions.

Regulatory Elements Necessary for Compliance

The Alliance's member companies remain committed to pursuing all technologies that have quantifiable GHG emissions and FE improvements both on-cycle and off-cycle. All stakeholders

[32] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at ES-2.

[33] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016), at ES-10, Table ES-3.

have acknowledged the contribution of these technologies to the environmental goals of the ONP with their inclusion in the regulation. The automakers' primary regulatory need is a renewed focus on removing all obstacles that are having the unintended result of slowing investment and implementation of these technologies. Agency action is needed to ensure that a simplified credit application process is quickly administered, including the establishment of processes for new technologies as they emerge. The Agencies should also reconsider the limits placed on recognizing the environmental impact of mobile air conditioning (MAC) improvements.

The Alliance proposes cooperating with the Agencies to develop technical studies needed to quantify the benefits of the next generations of innovative fuel savings technologies associated with safety and congestion mitigation from improved vehicle-to-vehicle and vehicle-to-grid communication, to car-sharing and car-hailing services. The Agencies should develop off-cycle credit frameworks to accelerate their implementation prior to MY2026. This includes addressing concerns with the AC17 test[34] used to quantify MAC system improvements. Actions to address the above will encourage, not slow, the introduction of technology.

Further details on the recommendations below are set forth in Appendix G.

Electric Vehicle Upstream Emissions and Incentives

All of the Draft TAR scenarios assume zero grams CO_2 per mile for the upstream emissions associated with generating electricity used as a transportation fuel. Complicating a shift towards electrification is the requirement in the regulation that holds automakers responsible for CO_2 from electricity generation at utility power plants. Automakers are already concerned about customer acceptance of electrified products in the market. This requirement further disincentivizes electrified vehicles from the regulatory perspective, degrading the CO_2 performance of plug-in hybrids to be similar to hybrid electric vehicles. This disincentive also works directly against the CARB ZEV mandate. Since the upstream utility emissions are being regulated by EPA and the states, they should not be assigned to automakers (none of which have control over their generation). The Alliance also recommends that the EPA extend the advanced technology vehicle multiplier through MY2025 to continue the promotion of electric, plug-in hybrid, and fuel cell vehicles.

Other Issues Discussed

Employment Impacts

The MY2017-2025 regulations specifically required the MTE to assess the employment impacts of the proposed standards. The Draft TAR chapter on employment consisted of exactly 14 pages

[34] 40 CFR § 1066.845

out of the 1,217-page Draft TAR. In the end, the Agencies concluded, "[b]ecause we do not have quantitative estimates of the output effect, and only a partial estimate of the substitution effect, we cannot reach a quantitative estimate of the overall employment effects of the standards on auto sector employment or even whether the total effect will be positive or negative."[35] The Alliance believes that more study, preferably including quantitative estimates as discussed in Appendix F, is needed to determine the employment impacts of the MY2022-2025 targets before a proposed determination or NPRM can be issued.

In addition to the major concerns summarized above, the attachments to this document cover a number of other issues:

- Agency cost optimization modeling (Appendix D)
- Alternative fuel infrastructure (Appendix I)
- Safety analysis (Appendix J)
- Miscellaneous issues (Appendix K)

Conclusion

The Alliance appreciates the analysis completed thus far by the Agencies for the Draft TAR, but has serious concerns with the analysis. Although on the surface the Draft TAR appears to be robust, multiple technical errors have combined to generate an implausible assessment of the technologies needed and the associated costs required for compliance through MY2025. In addition, the almost complete lack of assessment regarding consumer acceptance and other downstream impacts, with so little time remaining to correct these issues before the next steps of the midterm evaluation, is highly concerning and needs to be addressed. The Alliance expects to develop further input on the Draft TAR, and will submit that input as supplements to these comments. Given all the questions that now remain unanswered regarding the MTE but that must be addressed before April 2018, the Alliance and its member companies look forward to closer engagement with the Agencies prior to the next step of the process. In particular, we look forward to working with the Agencies' to address all of the factors that need to be considered per the 2012 FRM and the Energy Policy and Conservation Act[36] that have not been adequately addressed in the Draft TAR, to ensure a complete and accurate MTE.

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[35] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016), at 7-14.
[36] 49 U.S.C.A Section 329029(f)

Appendix A: Vehicle Level Technology Package Simulation Tools (ALPHA, AUTONOMIE, LPM)

Introduction

It is generally well known that because many GHG and fuel consumption reducing technologies address the same efficiency loss mechanisms, the benefits of those technologies in combination are not equal to the sum of their individual benefits. Therefore, manufacturers, suppliers, U.S. national laboratories, and the Agencies have developed modeling tools which account for technology synergies and dis-synergies to estimate the benefits of technology packages at a vehicle level. In the context of the Draft TAR, these models include EPA's Advanced Light-Duty Powertrain and Hybrid Analysis (ALPHA) model and Lumped Parameter Model. NHTSA utilized Autonomie, and to a lesser extent, a table of vehicle technology synergies.

Both ALPHA and Autonomie are what are termed "full vehicle simulation models" by the National Academies of Science[37] or "one dimensional models" by Novation Analytics.[38] Regardless of the specific terminology used, the ALPHA and Autonomie models are vehicle-specific, physics-based, and are generally expected to provide more accurate simulations than regression models, *if the inputs are accurate*.

The LPM (referred to by Novation Analytics as a "zero dimensional (0-D) model)[39] is a linear regression model, calibrated to full vehicle simulations provided by Ricardo to inform the 2012 FRM[40] and by simulations from the ALPHA model. The LPM is not vehicle-specific (only requiring a user to select from one of six generic vehicle classes), is limited to predefined drive cycles, and is generally expected to be most accurate for only the specific vehicle configurations to which it is calibrated.

Together these models (plus the baseline technology assessment) form the basis of the technology package benefits used by the Optimization Model for reducing Emissions of Greenhouse gases from Automobiles (OMEGA)[41] and CAFE Compliance and Effects Modeling System (Volpe)[42] optimization models to select a mix of technology to theoretically meet the

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[37] "Cost, Effectiveness and Deployment of Fuel Economy Technologies for Light-Duty Vehicles." National Academy of Sciences, National Research Council to the National Academies. 2015. 292.
[38] "Technology Effectiveness – Phase II: Vehicle-Level Assessment." Novation Analytics. 2016. 14.
[39] *Id.* at 14.
[40] *Id.* at 15.
[41] Optimization Model for reducing Emissions of Greenhouse gases from Automobiles (OMEGA). Environmental Protection Agency. Accessed September 25, 2016. https://www3.epa.gov/otaq/climate/models.htm.
[42] CAFE Compliance and Effects Modeling System: The Volpe Model. National Highway Traffic and Safety Administration. Accessed September 25, 2016.

future standards. Given that Novation Analytics and Oak Ridge National Laboratory agree that the technology penetrations selected by the OMEGA and Volpe models in the 2012 FRM were insufficient for compliance in MY2022-2025,[43] and manufacturers have indicated that their own modeling efforts show that this is still the case for those projected in the Draft TAR,[44] an examination of these vehicle-level technology package simulation tools is warranted.

The Alliance's analysis, albeit constrained by the 60-day comment period, identified a number of issues:

1. The engine maps used by the full vehicle simulation models do not fully consider key technical issues, and are therefore generally optimistic.

2. The LPM is fundamentally flawed and needs to be replaced by full vehicle (physics-based) simulation modeling, or at minimum, significantly upgraded.

3. The Agencies need to enhance their plausibility and quality control checks. The 2012 FRM modeling results included a large number of implausible values which could have easily been identified if plausibility and quality control checks were in place.

4. The Agencies' modeling is premised on maintaining vehicle performance, but the performance metrics used are insufficient to ensure that this goal is met.

Detailed comments are provided below.

Comments on the ALPHA Model

Although discussed in several SAE papers published by EPA,[45] and at a vehicle modeling workshop in March 2016,[46] the full version of the ALPHA model used to inform the Draft TAR and specific supporting materials (such as the engine map inputs) were not made available for

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http://www.nhtsa.gov/Laws+&+Regulations/CAFE++Fuel+Economy/CAFE+Compliance+and+Effects+Modeling+System:+The+Volpe+Model.

[43] *See* "Agency Modeling Outputs Do Not Match Third-Party Analyses" in the summary.

[44] Manufacturers have indicated in general terms, and without revealing any particular product strategy, that they believe the Agencies' projections do not reflect the technology mix which will be required to meet the MY2022-2025 GHG and CAFE standards and that a greater degree of strong electrification will likely be required.

[45] *See* Advanced Light-Duty Powertrain and Hybrid Analysis (ALPHA) Tool. Environmental Protection Agency. Accessed September 25, 2016. https://www3.epa.gov/otaq/climate/alpha.htm.

[46] *See* NHTSA, EPA and CARB workshop on technology effectiveness modeling methodologies for the midterm evaluation draft technical assessment report (TAR) analysis for CAFE standards and GHG standards. National Highway Traffic Safety Administration. Accessed September 25, 2016. http://www.nhtsa.gov/Laws+&+Regulations/CAFE+-+Fuel+Economy/nhtsa-epa-carb-workshop-03012016.

public review until the Draft TAR was released. As such, the Alliance can only provide limited comment at this time, and may choose to comment further in the future.

The Alliance and its member companies welcome direct engagement with EPA's technical modeling staff to discuss ALPHA model inputs and operation. We believe that in the case of full vehicle simulation modeling, it is reasonable to believe automakers and regulators can come to agreement on the benefits of technology if both parties are open minded to the technical and regulatory constraints and potential future improvements.

As described more fully in Appendix B, the Alliance is concerned that engine maps and other underlying data in the ALPHA model have resulted in over-optimistic projections of technology effectiveness.

Comments on the Autonomie Model

Similar to issues identified in the ALPHA model, the Alliance has concerns with the engine maps developed for use in the Autonomie model in support of the Draft TAR.

The Alliance appreciates that NHTSA provided the detailed engine maps used to quantify the technology effectiveness for the Draft TAR in advance of its release. Engine maps used for Autonomie modeling to inform NHTSA's analysis were developed using Gamma Technology's GT Power tool. [47] Although we acknowledge use of GT Power simulation modeling as an accepted approach by the industry to evaluate new technologies, it has widely recognized limitations in its ability to predict knock and combustion stability, and to accurately reflect control limitations such as cam slew rates. The Alliance would appreciate the opportunity to work with NHTSA to discuss these and other inaccuracies in more detail.

The following sections detail the concerns with the IAV Automotive Engineering (IAV) engine maps developed for use in Autonomie to inform the Draft TAR.

Concerns with the IAV Gasoline Engine1 Map:

The Alliance has the following concerns with IAV Gasoline Engine1 Map [48] (NHTSA Base Engine Map). This map was compared to two similar production engines.

- For low- to medium-load and sub-1,000 revolutions-per-minute (RPM) conditions, the brake specific fuel consumption (BSFC) data was deemed optimistic for typical dual

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[47] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 5-462.
[48] *Id.* at 505, Figure 5.200.

overhead cam (DOHC) engines. The NHTSA Base Engine Map does not reflect cam control limitations that are typical of commercial calibrations.

- Low RPM torque and knock are aggressive for a port fuel injection (PFI) gasoline engine with 10.2 compression ratio (CR).
- The NHTSA Base Engine Map is also very aggressive at lower loads. This is evidenced by a comparison of industry benchmark data for an engine that has the benefit of additional technology such as variable valve lift (VVL) and higher compression ratio.

Figures A-1 and A-2 below capture the BSFC delta comparison with the key findings. Figure A-1 is a comparison to an original equipment manufacturer (OEM) benchmark 2.0L, four cylinder (cyl), naturally aspirated (NA), PFI, DOHC, dual cam variable valve timing (VVT), 10.2 CR engine. Figure A-2 is a comparison to a Honda Accord 2.4L, 4cyl, NA, gasoline direct injected (GDI), DOHC, VVT, 2-step VVL, 11.1 CR engine benchmarked by the United States Council for Automotive Research (USCAR). These comparisons illustrate the optimistic assumptions in the NHTSA Base Engine Map, as the efficiency of the NHTSA Base Engine Map is similar to a production engine with much more technology.

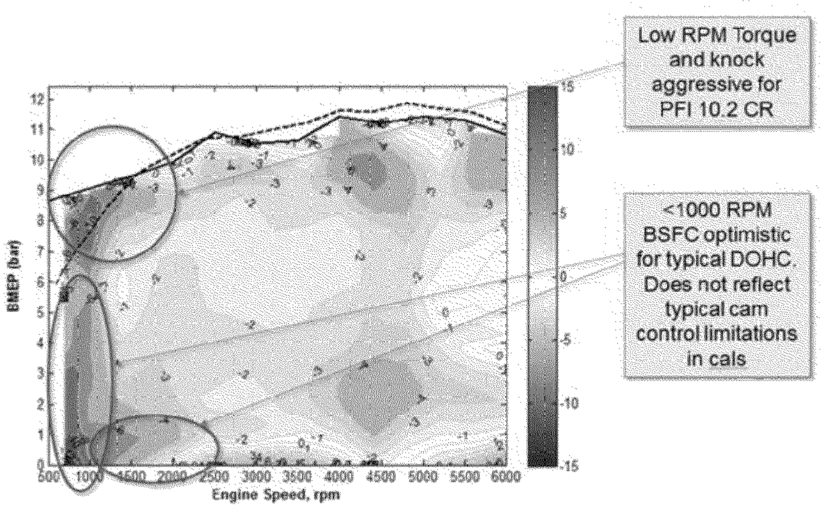

Figure A-1: Comparison of NHTSA Base Engine Map to similar OEM 2.0L Benchmark Engine

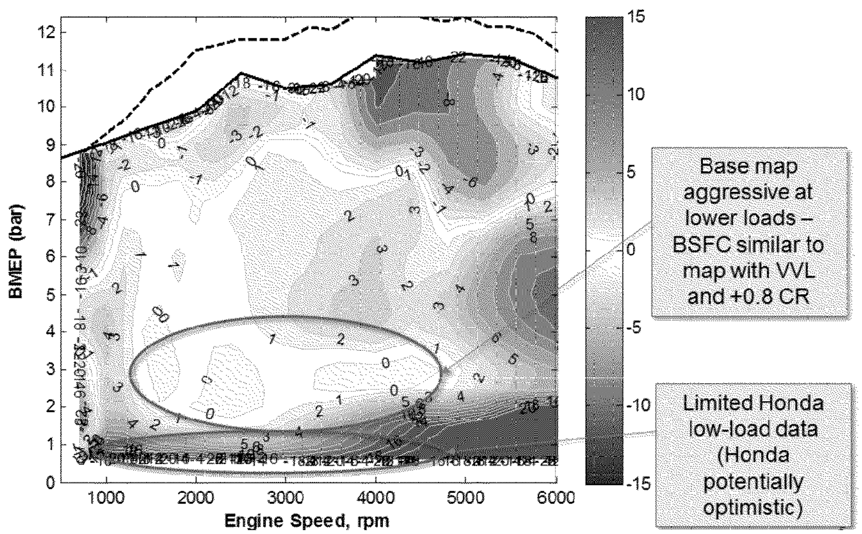

Figure A-2: Comparison of NHTSA Base Engine Map to Honda Accord 2.4L Engine

Concerns with the IAV Gasoline Engine2 Map

The following concerns are based on the analysis of the IAV Gasoline Engine2 Map, [49] which adds VVL to the NHTSA Base Engine Map:

- The increased torque and knock relief levels at low RPM are aggressive for just the addition of VVL to the base engine.
- The variable valve lift modeled appears to be continuously variable valve lift (CVVL); this should be clarified by NHTSA.
- At low load (less than two bar) the CVVL benefit modeled assumes excellent combustion, and the pumping work reduction with CVVL is overstated.

Figure A-3 compares the BSFC of the NHTSA Base Engine Map to the IAV Gasoline Engine2 Map with the key findings highlighted.

[49] *Id.* at 5-506, Figure 5.201.

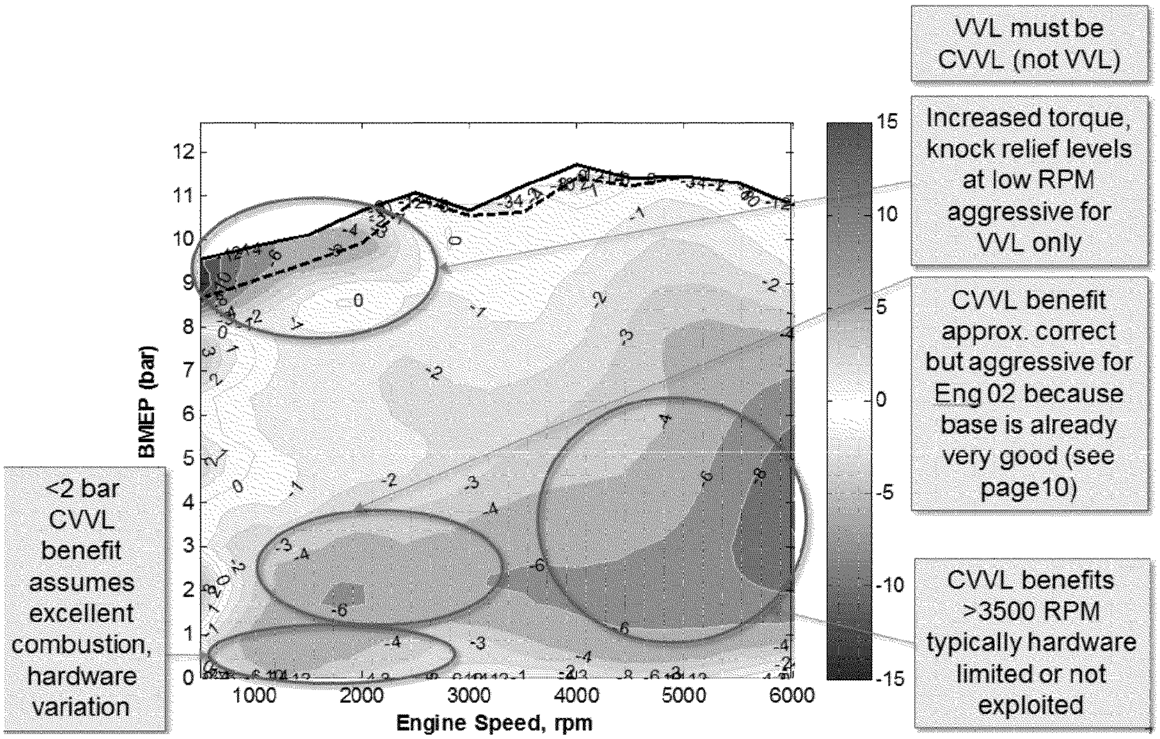

Figure A-3: Comparison of IAV Gasoline Engine2 Map to NHTSA Base Engine Map

Concerns with IAV Gasoline Engine3 Map

IAV Gasoline Engine3 Map [50] adds GDI technology and increases compression ratio by 0.8. When compared to IAV Gasoline Engine3 Map and the Honda 2.4L en gine map the following observations are made:

- The GDI pump friction isn't properly taken into account (Figure 1-4).
- Optimistic knock relief assumptions are used (Figure 1-4).
- Aggressive CVVL assumptions for low load operation were made ac ross the speed band (Figure 1-5).
- The pumping work reduction is o verstated, especially considerin g that the benchmark Honda engine used for comparison here is already a 2-Step VVL engine (Figure 1-5).

Figures A-4 and a-5 below capture the BSFC comparison with the key findings. Figure A-4 is a comparison to IAV Engine2 Map to isolate estimated GDI benefits . Figure A-5 is a comparison to the USCAR benchmarked Honda 2.4L engine with similar technologies.

[50] *Id.* at 5-506, Figure 5.202.

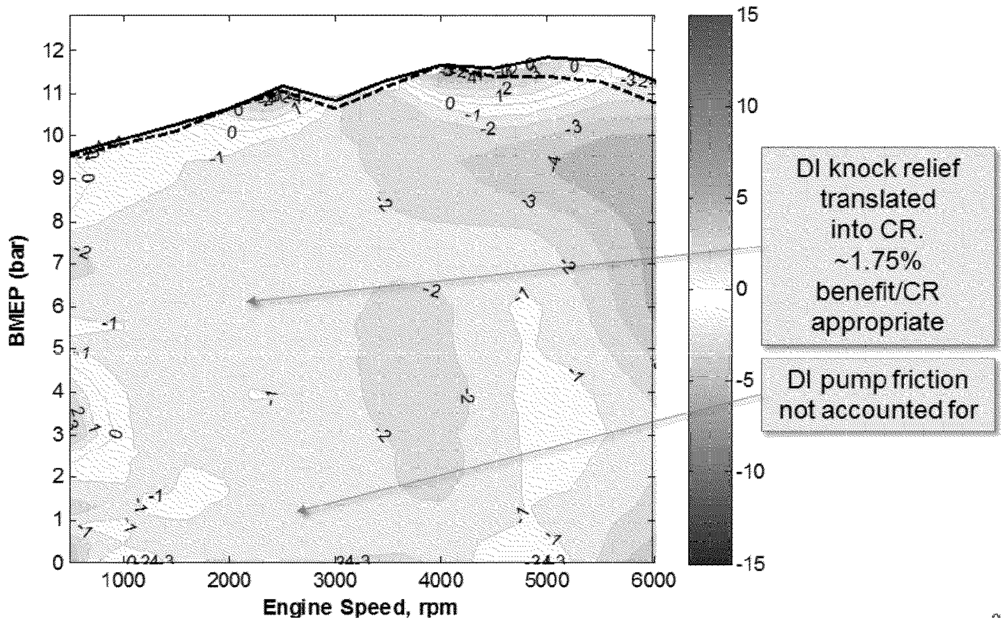

Figure A-4: Comparison of IAV Engine3 Map to IAV Engine2 Map

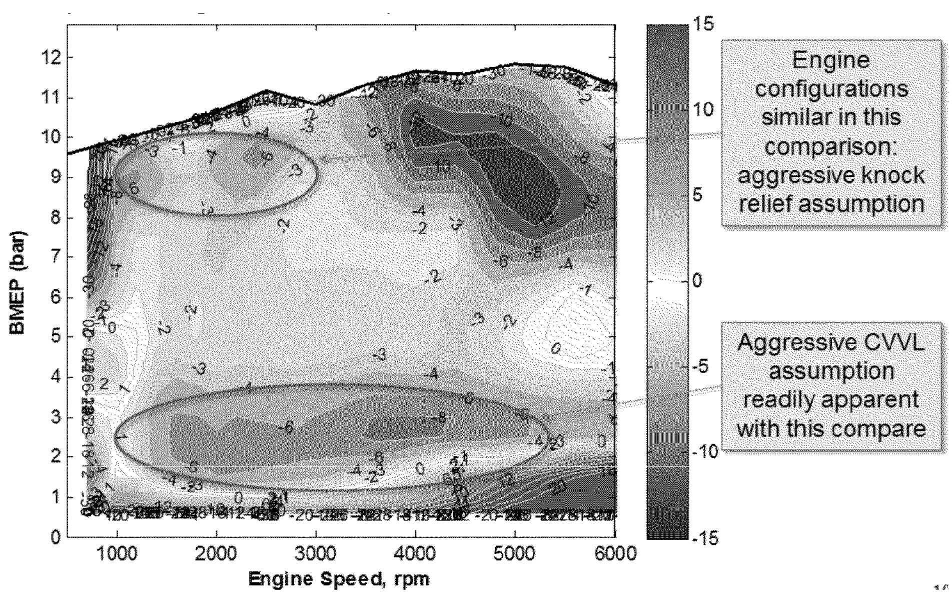

Figure A-5: Comparison of IAV Engine3 Map to Honda Accord 2.4L Engine

Concerns with IAV Engine4 Map

The following issues were identified with IAV Engine4 Map,[51] which adds cylinder deactivation technology to IAV Engine3 Map:

- The typical range of cylinder deactivation for production engines is limited to engine operation greater than 1,000 RPM to avoid idle interaction. However, IAV Engine4 Map does not display a low RPM limitation.
- Low load two-cylinder deactivation benefit is typically limited to the value seen at one bar brake mean effective pressure (BMEP). The IAV Engine4 Map suggests benefits below the one bar threshold and the map is overly optimistic in this area.
- The cylinder deactivation control system hysteresis for the transitions in and out of cylinder deactivation mode has been neglected.
- The approach of using a single map to characterize engines with cylinder deactivation technology may not take into account the transitional fuel usage during transitions in and out of cylinder deactivation mode.

Figure A-6 below captures the BSFC comparison with the key findings.

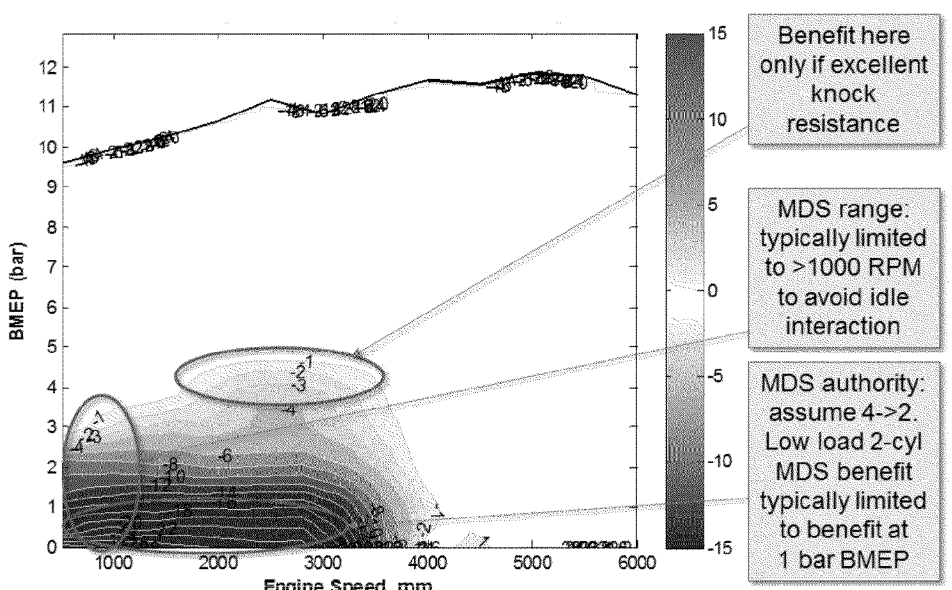

Figure A-6: Comparison of IAV Engine4 Map to IAV Engine3 Map

[51] *Id.* at 5-507, Figure 5.203.

Concerns with IAV SOHC Engine Maps

There are broad concerns with the four engine maps with single overhead cam (SOHC) technology. These include IAV Engine Maps 5b,[52] 6a,[53] 7a,[54] and 8a.[55]

- All four engine maps assume a large friction reduction (0.1 bar) across the board.
- Additional losses, due to loss in Effective Expansion Ratio (EE R) and the change to a fixed overlap volume (OLV), are not taken into account.
- Lower RPM torque reduction does not appear to be accounted for accurately.
- The benefit in the 2-4 bar region appears to be overstated give n that the cams cannot move relative to each other in SOHC engines.

Figures A-7, A-8, A-9, and A-10 below capture the BSFC comparisons to with the key findings:

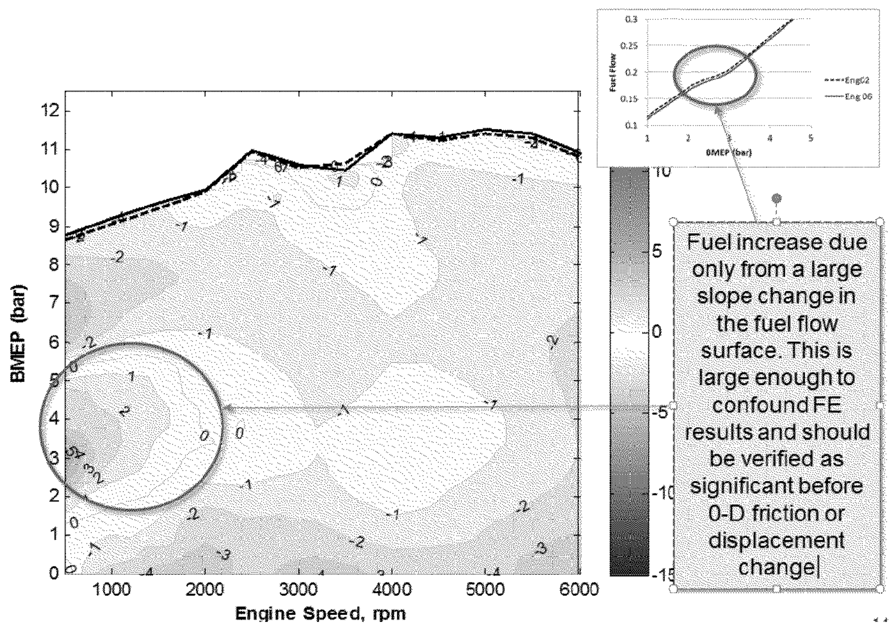

Figure A-7: Comparison of IAV Engine 5b Map to NHTSA Base Engine Map

[52] *Id.* at 5-507, Figure 5.204.
[53] *Id.* at 5-508, Figure 5.205.
[54] *Id.* at 5-508, Figure 5.206.
[55] *Id.* at 5-508, Figure 5.207.

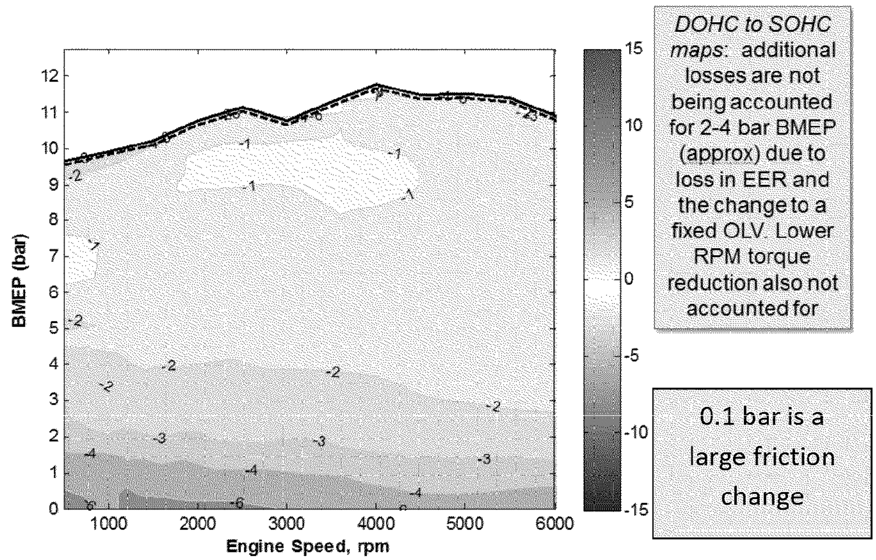

Figure A-8: Comparison of IAV Engine6a Map to IAV Engine2 Map

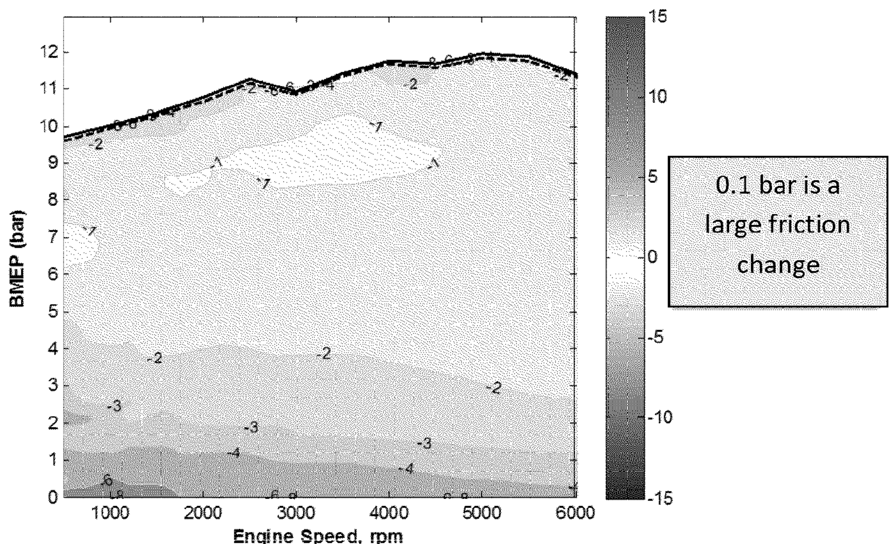

Figure A-9: Comparison of IAV Engine 7a Map to IAV Engine3 Map

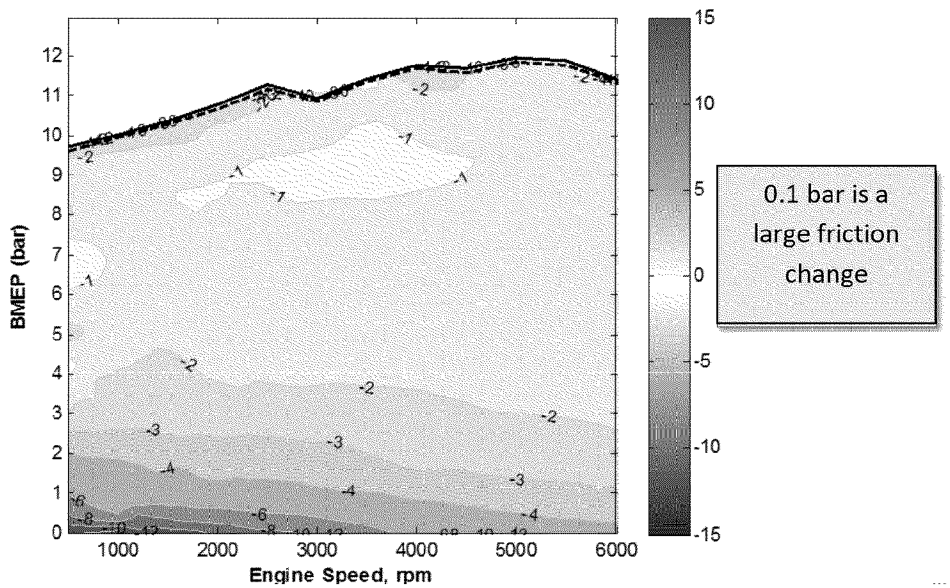

Figure A-10: Comparison of IAV Engine8a Map to IAV Engine4 Map

Concerns With IAV Boosted Engine Maps

We have concerns with IAV maps Engine12, [56] Engine13, [57] Engine14, [58] and Engine15. [59] The Draft TAR states, "IAV used gasoline with LHV = 41.3 MJ/kg for the mapping but the naturally aspirated engines were calibrated with 87 (R+M)/2 rating fuel and the turbocharged engines used 93 octane fuel."[60] The Alliance has grave concerns with NHTSA using premium fuel for turbocharged engines that do not otherwise require premium. As the Agencies are aware, automakers have to design for much lower octane commercial fuel available in the marketplace and Tier 3 91 RON certification fuel, unless the engine is one that requires premium fuel.

The broad concerns with the boosted engine maps used by NHTSA are listed below:

- The engine maps for boosted engines show best BSFC all the way to full load; this is not typical.
- For boosted engines with CEGR, the low-pressure CEGR (LPCEGR) effect appears exaggerated.

[56] *Id.* at 5-509, Figure 5.208.
[57] *Id.* at 5-509, Figure 5.209.
[58] *Id.* at 5-510, Figure 5.210.
[59] *Id.* at 5-511, Figure 5.211.
[60] *Id.* at 5-504.

- Low load BSFC data for some boosted engine maps assumes excepti onal stability or low friction.
- The optimum use of LPCEGR relative to the intake cam movement a ppears to result in overstated efficiency improvements.

Figures A-11 and A-12 illustrate the above issues with the key findings with the IAV Gasoline Engine12 Gasoline Engine13 maps.

Figure A-13 captures the effect of a 0-D displacement change fr om 1.6L to 1.2L (downsizing effect).

Figure A-14 below illustrates the effect of aggressive LPCEGR on the 1.0L 3-cylinder engine.

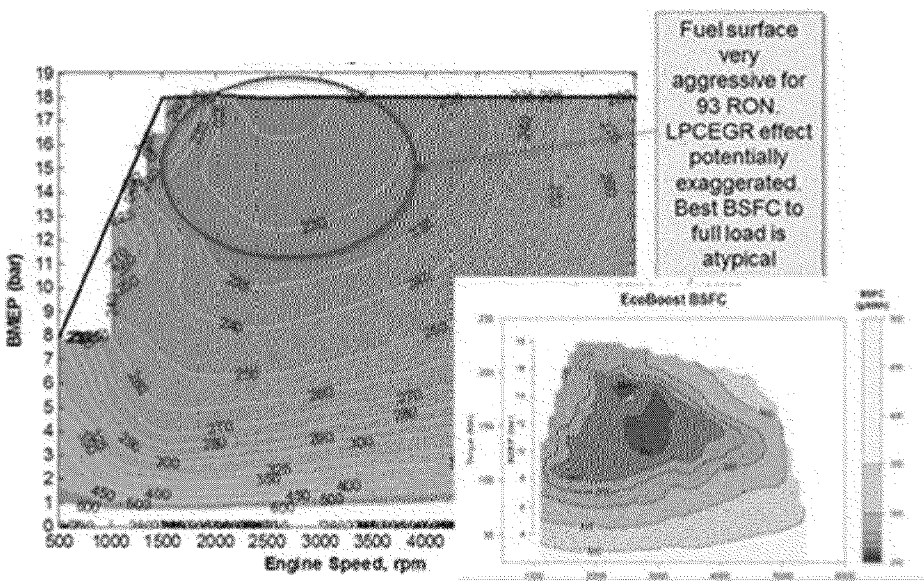

Figure A-11: IAV Gasoline Engine12 Map - Atypical Fuel Surface for Downsized Turbocharged Engines Running on 93 RON Fuel

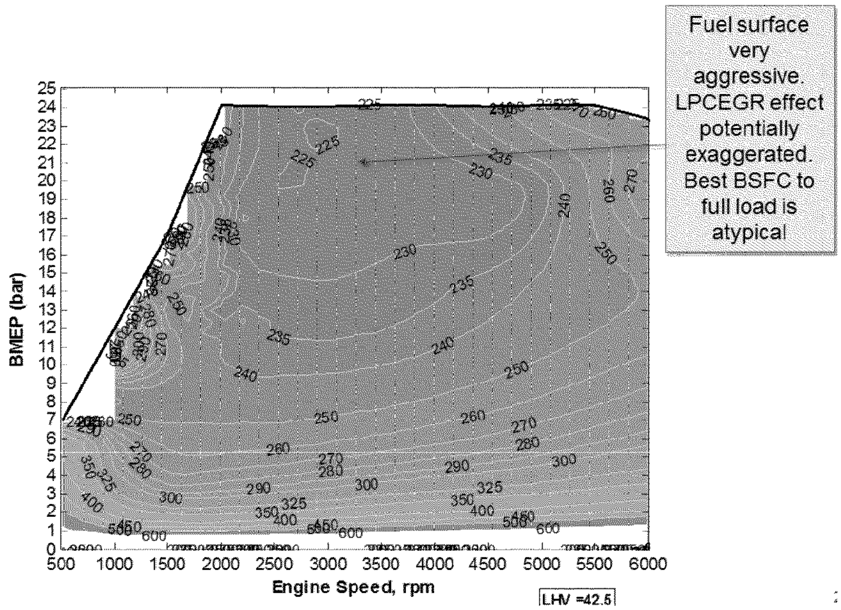

Figure A-12: IAV Gasoline Engine13 Map - Aggressive Fuel Surface With Atypical Results

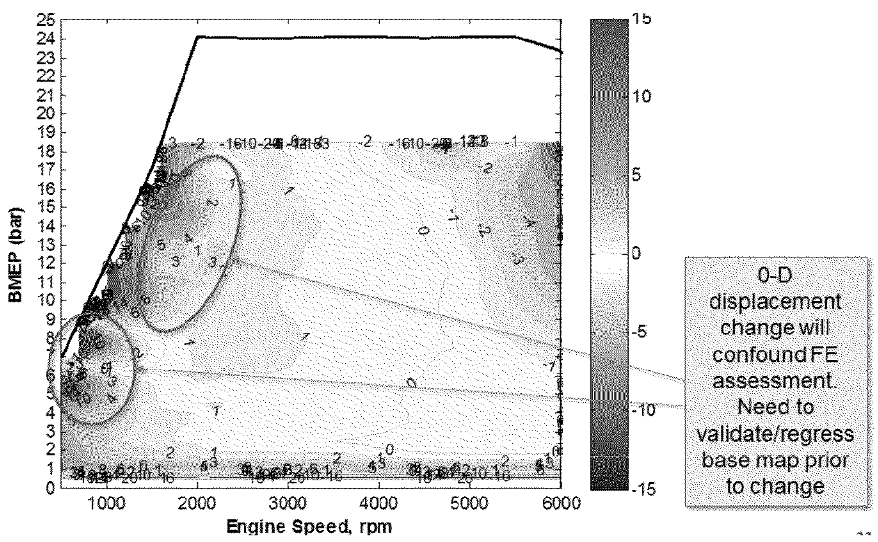

Figure A-13: Comparison between IAV Gasoline Engine12 Map and IAV Gasoline Engine13 Map; Displacement Change without Full Modeling Questionable

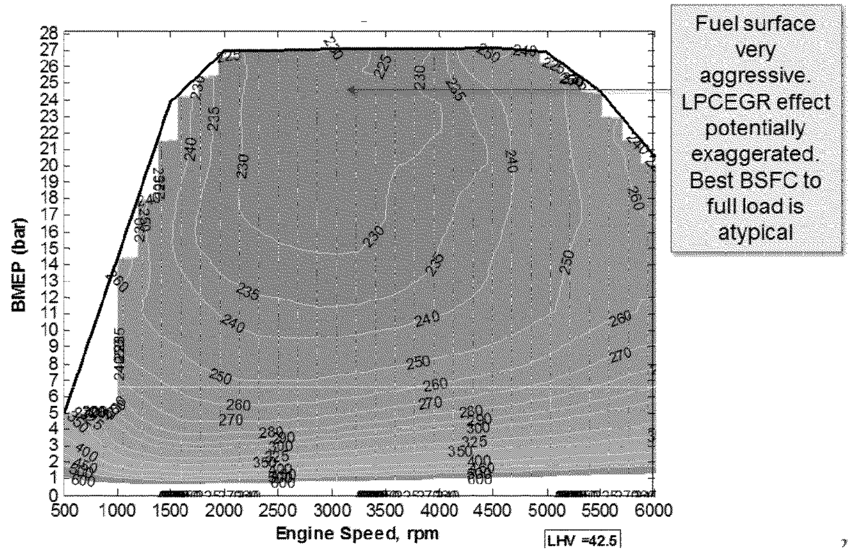

Figure A-14: IAV Gasoline Engine14 Map - Aggressive Fuel Surface With Atypical Results

Summary of NHTSA Fuel Map Findings

The primary focus on the use of the IAV engine maps appears to be the operating regions during the city and highway test cycles and thus there may have been more emphasis to precision given to the speed load points that favor the certification cycles. However, for a commercial engine package, the compromises needed to deliver acceptable engine performance at all speed load points will negatively impact the regions of the maps that are prevalent during the certification cycles.

The Alliance appreciates NHTSA accepting the feedback of automakers during the Modeling Workshop and supports its efforts to ensure that all future engine model development is performed with regular grade octane gasoline. The Alliance assumes that this work will be completed before the NPRM is published. The Alliance also supports NHTSA's commitment to develop new high-fidelity models to represent potential future technologies. However, the Agencies should also recognize that given the timeframe and all the constraints involved in bringing new engine architectures to the market, the introduction of any new technologies not already captured by the Agencies during the Draft TAR process may be beyond the broad-scale implementation framework for MY2022-2025.

Issues Applicable to Both the ALPHA and Autonomie Models

There are a number of technical flaws that are common to both the ALPHA and Autonomie models which bias the full vehicle simulations to more optimistic benefits than those anticipated by automakers.

Tier 3 Emissions

The Alliance recommends that both Agencies account for the CO_2 and FE degradation associated with Tier 3 emissions control systems and the impact of more stringent evaporative emissions regulations in their MTE analysis. The effect of the evaporative emissions regulations is further magnified for engine stop-start and HEV applications where the engine off option is constrained by the need to purge the canister for evaporative emissions requirements. The Tier 3 final rule and associated regulatory impact analysis (RIA), plus various Tier 3 docket comments, discuss this matter in detail. The Alliance will gladly work with the Agencies' technical staff to inform the appropriate models of the impact of Tier 3 emissions compliance.

CARB PM (1 mg/mi)

The Alliance recommends that both Agencies account for and include the detrimental impact of CARB particulate matter (PM) (1 mg/mi) particulate matter regulations on CO_2 and FE performance in the MY2022–2025 timeframe. The 1 mg/mi PM (1) requirement could impact approximately 40% of the fleet. The Alliance will gladly work with the Agencies' technical staff and provide guidance on how to model the impact of CARB PM (1) on future compliance.

Baseline Vehicle Electrical Loads

The Alliance suggests that the Agencies harmonize around the NHTSA base electrical accessory loads of 240 W. The base electrical loads used by the Agencies differ by a factor of two. The EPA fleet average base load of 490W is too high to accurately represent a fleet average. Table A-1 below shows what the Agencies are using for baseline electrical loads while Table A-2 demonstrates the two-cycle average base load in watts for a sampling of North American products across several vehicle segments. While there are some vehicles that do reach 490W and greater, the average two-cycle base load of the sample vehicles is 387W. By inflating the base electric load, EPA has effectively overestimated the effectiveness of load reduction technologies.

Table A-1: Agencies Baseline Electrical Loads

Assumption	Base Load	Reference	TAR Document
EPA	490 W	Chevrolet Malibu and some others	Page 5-266
NHTSA	240 W	ANL Autonomie Software	Pages 5-503 and 5-526

To assist the Agencies in developing an accurate and harmonized start point, the Alliance is providing the following benchmarking data from a collection of late model vehicles.

Table A-2: Electrical Base Load Benchmarking Data[61]

Vehicle	2-Cycle Average (W)
2013 Lincoln Navigator L	430
2015 Cadillac Escalade ESV	360
2016 Cadillac ATS	293
2014 Chevy Cruze LTZ	306
2014 Chevy Sonic LTZ	228
2015 Chevy Tahoe LTZ	368
2013 Audi A8 L 4.0T	578
2013 Mercedes GL450	581
2014 BMW X5 xDrive35i	491
2016 BMW X5 xDrive35i (Start/Stop ON)	519
2015 Lexus NX200t	315
2015 Volvo XC60 T6 DRIVE-E	420
2015 Kia Soul !	298
2015 Hyundai Elantra Limited	244
2016 Honda Pilot Elite (Start/Stop OFF/ON)	516
	517
2016 Ford Fusion	275
2016 Ford F-150	318
2015 GMC Sierra	291
Vehicle Average	**387**

To further assist the Agencies in accurate electric load modeling, the Alliance is providing Table A-3 from the American Automotive Policy Council (AAPC) Heavy Duty Greenhouse Gas Phase 2 public comments.[62] This table demonstrates a typical breakdown of electrical load.

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[61] Courtesy of Ford Motor Company and General Motors.
[62] Docket ID EPA-HQ-OAR-2014-0827-1238.

Table A-3: 2015 GMC Sierra Light-Duty Pickup 6.2L V8 Power Consumption Test Data (Watts)[63]

	FTPCity	FTP	US06
Electrical Power			
Total Load Power	319.9	254.8	286.5
MGU Power	410.5	248.5	274.5
12V Batt Power	-	6.34	12.00
12V Batt Voltage	14.43	12.76	12.70
BCM 6 Power	31.71	10.97	21.28
BCM 7 Power	23.12	4.06	14.71
Powertrain Power			
Engine Management System			
ECM Batt Power	3.69	3.74	3.67
ECM IGN Power	0.37	0.29	0.29
ECM Power	26.38	31.68	37.96
Fuel Pump MOD Power	29.79	28.41	31.20
Ignition Coil Even Power	6.22	7.49	9.50
Ignition Coil Odd Power	6.24	7.53	9.46
MAF Power	1.57	1.46	1.53
O2 HTR Post Power	13.52	6.89	3.57
O2 HTR Pre Power	40.76	34.49	22.18
Propulsion Control Power			
TCM Batt Power	40.61	23.17	27.77
Thermal			
Propulsion Thermal Power			
Cooling Fan 1 Power	4.45	13.16	15.94
Cooling Fan 2 Power	3.99	10.81	12.39
HVAC Thermal Power			
AC Clutch Power	0.00	0.01	0.01
Front Blower Power	0.05	0.07	0.13
Chassis			
Chassis Power			
ABS Pump Power	0.03	0.09	0.03
ABS Valve Power	3.93	3.66	3.67
EPS	3.56	3.06	3.24
Body/VASS Power			
CHMSL Power	8.25	1.75	5.40
Infotainment/Telematics Power			
Audio AMP Power	7.90	7.07	6.99
OnStar Power	3.18	3.16	3.18
Radio NAV Power	12.37	12.09	12.05
Saftey Active/Passive Power			
Airbag Power	3.88	3.86	3.86

[63] *Id.* at 43.

Gasoline Fuel Properties

The Alliance recommends that NHSTA and EPA harmonize and use regular grade Tier 3 test fuel for all future analysis, unless testing "premium required" engines. We note that the mixed use of fuel by both Agencies made detailed comparisons between some technologies impossible to complete during the 60-day comment period.

In addition, Tier 3 test fuel also contains 10% ethanol, lowering the energy content of the fuel. The Alliance supports EPA's ongoing efforts to develop appropriate adjustments to account for the resulting lower fuel economy.

Engine Downsizing

Engine downsizing is inherent to the Agencies' estimates of benefits. For example, if a technology adds performance to a vehicle, the Agencies readjust the vehicle design, usually with engine downsizing, to maintain performance neutrality, and the subsequent benefits of the downsized engines are added to benefits of the technology.

The Agencies fail to consider the availability of downsized engines

When adjusting engine size to maintain performance, EPA assumes that any resulting engine displacement will be available, maximizing the modeled benefits of various technologies. In practice, manufacturers have a limited number of engine displacements to choose from and will likely select the size of engine that maintains or improves performance.[64] EPA's assumption of infinite engine displacement availability yields unreasonably optimistic results. Flexible manufacturing techniques, already widely in-use, do not allow for infinite displacement variation.

It is our understanding that NHTSA has provided some constraints when assuming the availability of downsized engines. We support this direction and urge NHTSA to verify that its methodology is consistent with normal business practices of sharing engines across multiple platforms and minimizing the total number of displacements built given engine plant capacity and capital constraints.

The Agencies fail to consider displacement to mass ratio constraints

As is discussed further in the Alliance's specific comments on downsized and turbocharged engines, displacement to vehicle mass ratio (D/M) provides a simple means to assess whether the degree of downsizing will find market acceptance. By failing to consider this parameter, the Agencies could model engines which will not gain customer acceptance. We recommend that

[64] *See* further discussion in Appendix E regarding customer expectations for continuous improvement, as opposed to maintaining a previous generation's features.

both Agencies review the comments on downsized turbocharged engines and add a constraint which considers the displacement to mass ratio.

The Agencies do not account for top gear grade-ability

A key metric needed to maintain performance neutrality is top gear grade-ability. In contrast, the main metric by which performance neutrality is measured by the Agencies is 0-60 acceleration time. As discussed in the Draft TAR Section 5.3.1.2, EPA considered several other metrics including 0-30 time, ¼ mile time, 30-50 passing time, 50-70 passing time, and trailer towing (for trucks only). However, EPA noted that "[w]ithin the [2012] FRM analysis, the 0-30 mph and 0-60 mph performance window criteria were found to be sufficient to maintain equivalence with other indicators of vehicle performance and utility, including trailer grade-ability."[65] The common element of most of the Agencies' performance tests is that they occur in the lower gears of transmission operation. But none of the metrics evaluated is a substitute for top gear grade-ability.

Top gear grade-ability is the ability of a vehicle to negotiate a grade in top gear without downshifting. If the top gear ratio is too low, every time a driver encounters a small hill or wants to accelerate from a steady speed on a level road, the transmission would have to downshift. Unnecessary downshifting leads to customer acceptance issues. To avoid this problem, manufacturers check for top gear grade-ability. EPA and NHSTA should perform a similar check, by vehicle (since engine displacement, transmission, and final drive ratios are critical to this metric), to verify that grade-ability is not degraded by downsizing.

It should be noted that grade-ability is one of the metrics a 2011 report by the National Research Council identified,[66] and EPA quoted on page 5-225 of the Draft TAR, as being required for "truly equal performance." Top gear grade-ability should also be relatively easy to calculate and compare.

Lumped Parameter Model

The Alliance and its member companies support full vehicle simulation over the LPM. We recognize and support NHTSA's intent to utilize full vehicle simulations for all modeling to inform its *de novo* rulemaking for MY2022-2025.[67] Manufacturers generally rely on full vehicle simulations to estimate the benefits of technology packages applied to future vehicles when

[65] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 5-226.
[66] "Assesssment of Fuel Economy Technologies for Light-Duty Vehicles." National Academy of Sciences, National Research Council to the National Academies. 2011. 62.
[67] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 5-458, Figure 5.148.

developing their compliance plans due to their greater accuracy, ability to model specific vehicles, and capability in modeling the full range of customer operating conditions. Both EPA and NHTSA agree that full vehicle simulation models provide superior results when estimating the benefits of combinations of technologies.[68]

Novation Analytics identifies the Lumped Parameter Model as a Key Source of Technology Package Benefit Assessment Errors

In its Fleet Level Tech Effect Study[69], Novation Analytics identified that projections of technology penetration from the 2012 FRM at a fleet level were insufficient to meet the MY2021 and MY2025 standards. The Alliance requested that Novation Analytics explore this issue in more detail.[70] In so doing, Novation Analytics found that the LPM yields implausible results, particularly for vehicles with higher baseline efficiency.

Novation Analytics identified the following issues with the LPM:[71]

- The vehicle's baseline (i.e. starting point) efficiency is critically important for projected benefits of additional technology, but this is not accounted for in the LPM.
- The linear regression models within the LPM are not based on the first order determinants of powertrain efficiency and, therefore, do not properly capture the fundamental trends. This leads to a consistent over-projection [of technology benefit] when applied to efficiency-oriented vehicles (which are often the high volume vehicles).
- The [A]gencies' modeling processes do not recognize the inherent variability of efficiency within the light-duty fleet, treating all products within a category as equal. Without limits in the process, this approach results in overprojection of the most efficient vehicles.
- No procedure or methodology is currently in place to check the outcomes of the [LPM's] technology effectiveness projection process against logical efficiency metrics and limits. Without such checks, the outcomes can exceed plausible limits. (The Alliance further notes, to our knowledge, EPA has not checked the results obtained from the LPM against the ALPHA model or actual vehicles, except in the limited cases where the LPM is specifically calibrated to the ALPHA model results.)

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[68] *Id.* at 5-271 and 5-458.
[69] "Technology Effectiveness – Phase 1: Fleet-Level Assessment." Novation Analytics. 2015.
[70] "Technology Effectiveness – Phase II: Vehicle-Level Assessment." Novation Analytics. 2016. 12.
[71] *Id.* at 8.

We refer EPA to the Novation Vehicle Level Tech Effect Study, [72] particularly the section entitled "Identification of Agency Modeling Process Issue(s)" for further discussion on why the LPM is likely to overestimate the benefits of technology for some vehicles.

Further analysis of the Lumped Parameter Model by the Alliance also indicates potential problems

The Alliance performed the following analysis in an effort to better understand LPM and to identify specific areas of concern. The Alliance recognizes that in doing so, we exercised the LPM in a different manner, but we are confident that the method was sound and the results worthy of comment and further discussion with the Agencies.

The reason we had to approach the analysis this way is because the LPM shows fuel consumption improvements relative to a "null" vehicle. Manufacturers can model new technology packages, but lacking the counterpart null vehicle data, we cannot make direct comparisons.

To circumvent this lack of data and still provide timely insight on model accuracy, the Alliance analyzed the absolute CO_2 predictions from the LPM. We acknowledge this differs from the LPM's intended function which is to calculate the percent improvement from null.

For comparison, the actual CO_2 data from the MY2014 fleet was used. All of the data used to perform this analysis was contained in files supplied by EPA in support of the Draft TAR.

The following describes the specific process followed in the analysis and the results obtained.

Although the EPA provides an executable graphical user interface (GUI) of its LPM for general public review, [73] the actual tool used to inform EPA's OMEGA model is the "Vehicle Energy Effects Estimator" located within the OMEGA "Machine" preprocessor spreadsheets.[74]

To generate the CO_2 estimates from the LPM, the MY2014 data compiled by EPA for the Draft TAR was used:

- Column V of the "Vehicle" sheet of "Market_Ref_in2025B_central.xlsm" shows the baseline CO_2 values for the individual MY2014 vehicles.
- Column GE of the same sheet and file shows the baseline (Tech Package 0) technologies.

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[72] *Id.* at 38.
[73] Lumped Parameter Model (LPM) for Light-Duty Vehicles. Environmental Protection Agency. Accessed September 19, 2016. https://www3.epa.gov/otaq/climate/lpm.htm.
[74] Electronic mail from Michael Olechiw, EPA to Michael Hartrick, Alliance. August 19, 2016.

- Columns AO through AR of the "Baseline" sheet of "Machine_2014B_rpe.xlsb" show road load at 50 MPH, equivalent test weight (ETW), rated torque, and rated power, respectively.

To perform the analysis, the technology information was extracted from Tech Package 0 for each vehicle and then applied to the "Vehicle Energy Effects Estimator tool" (Estimator) using the "Custom" vehicle type. The Estimator then provided a CO_2 estimate from cell M29, the result of which can be compared to the actual CO_2 from the MY2014 baseline vehicle.

An Excel macro was developed to automate this routine so that every vehicle could be analyzed. The limited number of EVs, range-extended electric vehicles (RE EVs), compressed natural gas (CNG), and propane-fueled vehicles in the dataset were excluded from the analysis to minimize noise.

The results of this process, after sorting for conventional technologies (no hybrids, turbocharged engines, or eight-speed transmissions), are plotted below in Figure A-15. In this and the following figures, results below the line show data where the LPM predicted lower CO_2 than the vehicle actually emitted. Conversely, points above the line show when the vehicle was better than the LPM estimate. The standard error for this data is 3 g/mi, but the overall slope calculated as a best-fit line is about 2% from actual.

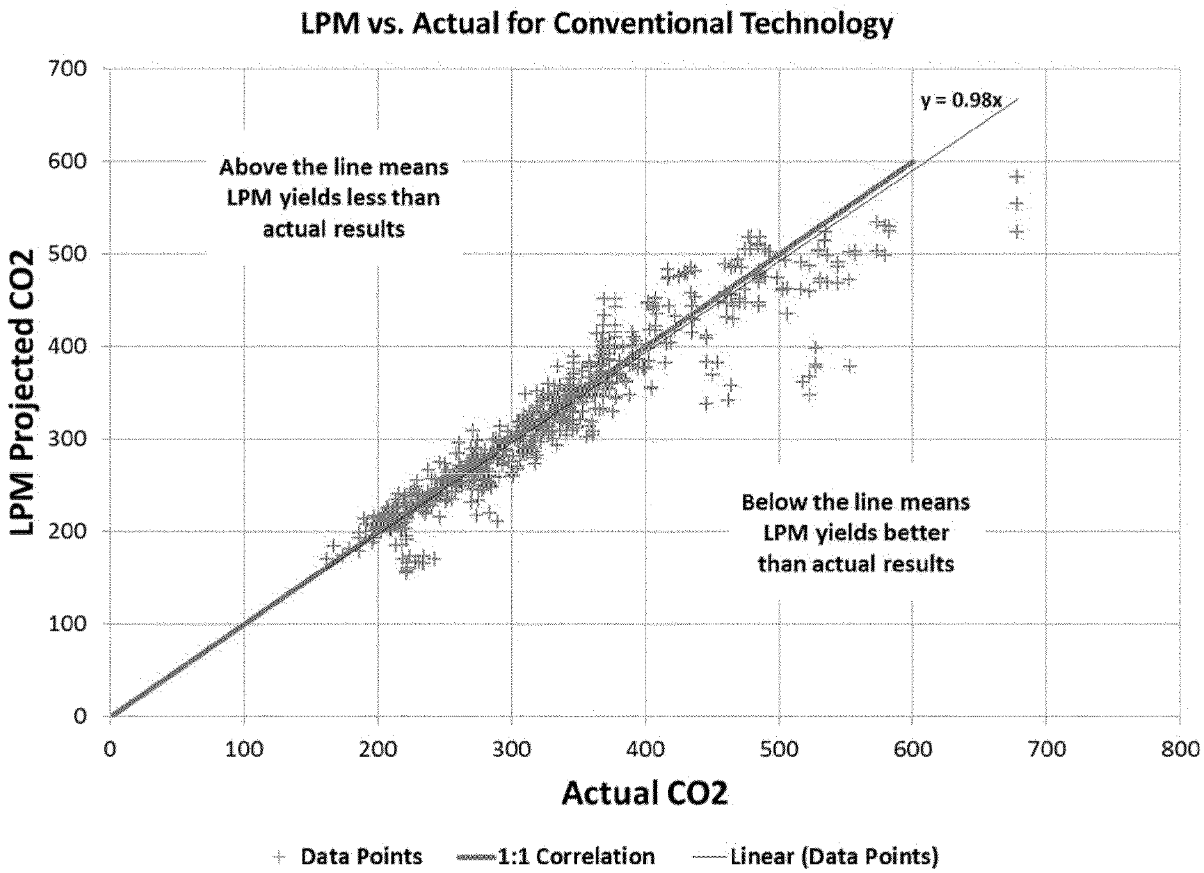

Figure A-15: Lumped Parameter Model compared to Test Data

Figure A-16 shows the data after filtering for only eight-speed transmissions. Here the standard error has increased to 49 g/mi, but of greater concern is the c hange in slope of the best-fit line. The overall trend shows that the LPM is more optimistic by 12% than what manufacturers have, on average, been able to deliver. This is the powertrain techn ology, aside from variable valve timing, with the highest projected penetration (~90%) from the OMEGA model.[75]

[75] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 12-29, Table 12.33.

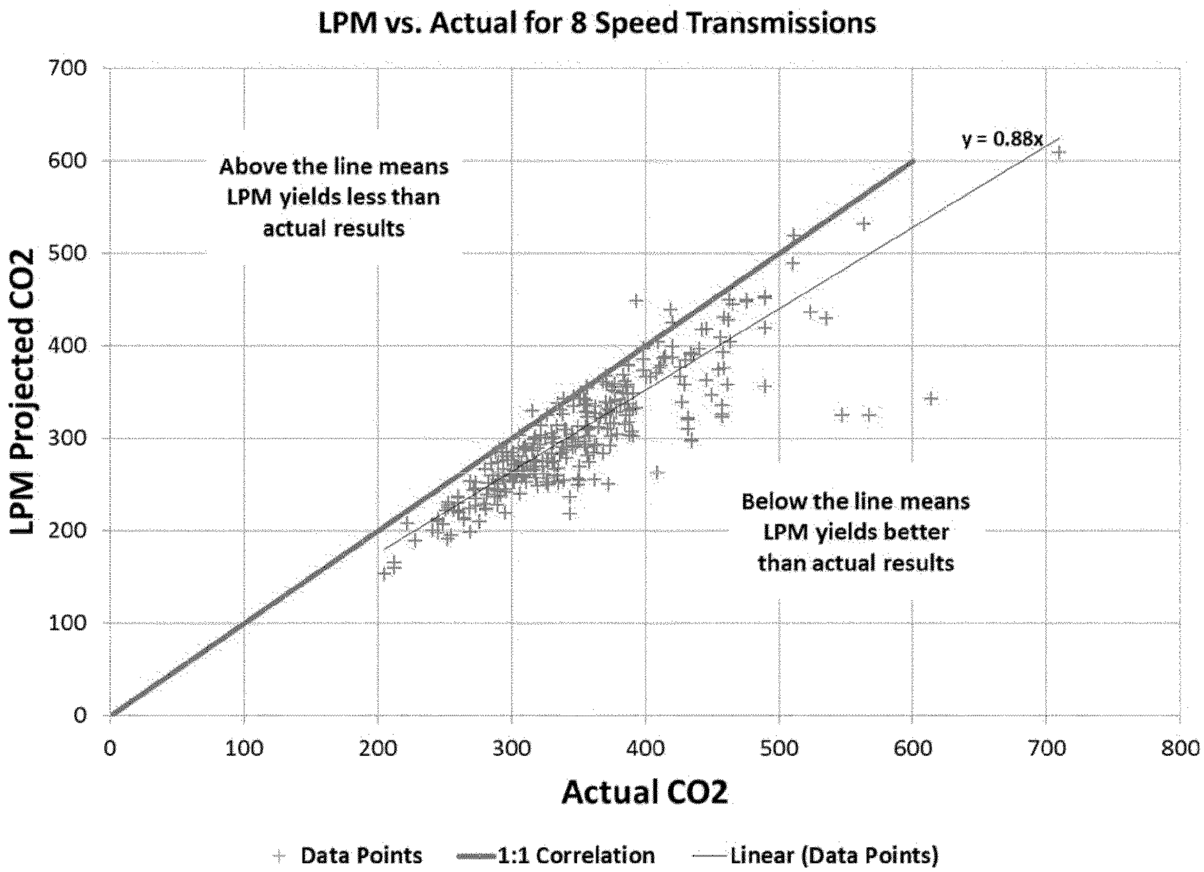

Figure A-16: Lumped Parameter Model compared to Test Data of Vehicles with 8-Speed Transmissions

Two major concerns from this study are the accuracy of the LPM and an optimistic bias for some technologies like the eight-speed transmission (shown above).

The Alliance recognizes that no model is ever perfect, but give n the impact of these regulations on manufacturers, we ask that EPA use every available method to improve its tools. Analyses such as this should be used to identify the greatest errors and then develop stra tegies to resolve them, if that is even possible. That is, at some point the bro ader question would be whether EPA should just use full vehicle simulations as NHTSA has done.

The Alliance looks forward to sharing and discussing this study with EPA to advance the MTE process.

Full vehicle simulation is practical to implement to inform the OMEGA and Volpe models.

The EPA contends that "developing and executing every possible combinations [sic] of technology directly in a fleet compliance model using full vehicle simulation would not be practical to implement."[76]

Setting aside whether there is a need to execute such a model " directly in a fleet compliance model," the Alliance disagrees with EPA's assessment that "full vehicle simulation would not be practical to implement" to inform the OMEGA model. NHTSA has indicated that it intends to use full vehicle simulation modeling to inform the Volpe model and visually described a "large scale simulation process" using multiple networked processors as an enabler in Figure 5.148 of the Draft TAR. [77] Similarly, Novation Analytics has proposed to the Alliance that it replicate every simulation used to inform OMEGA with its full vehicle simulation software *Energy* for comparison.

Furthermore, manufacturers must evaluate various product plans for compliance, in an exercise similar to those efforts undertaken by the Agencies in their use of the OMEGA and Volpe Models. Manufacturers face the same challenges in evaluating a broad range of technology packages for individual vehicles and are able to adequately inform their own efforts using full vehicle simulations as opposed to models like the LPM.

Alliance Recommendations Regarding the Lumped Parameter Model

The Alliance recommends the following:

1. Cease use of the LPM as a tool to inform the OMEGA and Volpe models in favor of full vehicle simulation modeling such as that provided by ALPHA and Autonomie.

2. If EPA cannot identify the means to implement the Alliance's recommendation to cease use of the LPM,[78] the "LPM should be enhanced and upgraded to incorporate the key vehicle and powertrain parameters which determine powertrain efficiency."[79]

3. If the EPA continues use of the LPM, it should, at minimum, perform a quality check of the LPM results against a variety of actual vehicles (in particular, relatively higher efficiency vehicles to which the LPM was not specifically calibrated). The results of these quality checks should be provided with the LPM documentation for public review.

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[76] *Id.* at 5-271.
[77] *Id.* at 5-459.
[78] As previously discussed, the Alliance does not see a valid reason why EPA cannot use full vehicle simulation modeling in place of the LPM given that manufacturers, consultants, and NHTSA have all found a means to do so.
[79] "Technology Effectiveness – Phase II: Vehicle-Level Assessment." Novation Analytics. 2016. 44.

Plausibility Checks

Model inputs, design, and underlying assumptions play a key role in determining the accuracy of the final output of any vehicle-level technology package simulation. In the Novation Analytics Vehicle Level Tech Study,[80] a series of three plausibility checks designed for use as high-level[81] liberal checks of modeled powertrain effectiveness were designed. The Alliance recommends these plausibility checks to EPA and NHTSA as a filter for their modeling outputs. Outputs which fail these simple plausibility checks should be re-examined for potential errors in the modeling inputs or in the model design itself. Further information describing these plausibility checks, the limits chosen (and justification thereof), and applicability to various types of modeling can be found in the "Plausibility Assessment Methodology" section of the Novation Vehicle Level Tech Study.[82] The plausibility checks are:

1. Conversion Efficiency Proxies: This plausibility check is based on the assumption that future technology will not exceed the level of other more efficient technologies already demonstrated in the fleet (e.g. diesel engine efficiency as a proxy for future advanced gasoline engine efficiency). The Novation Analytics analysis of the 2012 FRM indicated that 40% of the samples exceed this plausibility check.[83]

2. On-Cycle-to-Peak Engine Efficiency Ratios: This plausibility check is based on differences between the operating conditions on the city and highway cycles and the peak efficiency operating point. In the 2012 FRM, some of the Agency modeled on-cycle efficiency results actually exceeded the peak engine efficiency (an impossible condition to achieve).

3. City-to-Highway Cycle Efficiency Ratios: This plausibility check uses historical ratios of highway and city cycle efficiency[84], adjusted for future improvements. This check can only be applied to full vehicle simulation results (the LPM does not provide separate city and highway cycle results). Novation Analytics checked the Ricardo simulation results (used, in part, to calibrate the LPM) and determined that in *all* cases, the results failed this plausibility check.

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[80] *Id.*
[81] The limits chosen are designed to allow as many passing results as possible and to only flag issues when there is a near or absolute certainty that the tested outputs are implausible.
[82] *Id.* at 20.
[83] *Id.* at 32.
[84] Highway cycle operation is typically more efficient than city cycle operation for conventional internal combustion engine-powered vehicles.

Full Vehicle Simulation Modeling Quality Control Checks

The Alliance recommends that the Agencies incorporate and make readily available quality control parameters that can be used to verify the validity of model results in all output files. At a recent workshop on their modeling efforts to inform the MTE, [85] the Agencies and automakers freely and openly discussed the beneficial merits of including quality control checks in the modeling data. The Alliance recommends that the Agencies harmonize the entire quality control check list and incorporate it into the next phase of the MTE. The Alliance also suggests adding these additional parameters:

- Top gear N/V ratio at 50 mph
- Tire Size (rev/mile)
- UDDS Phase 1 Fuel Consumption (gallons/mile)
- UDDS Phase 1 Cycle Energy (joules) CE per SAE J2951
- UDDS Phase 1 CO_2
- UDDS Phase 2 Fuel Consumption (gallons/mile)
- UDDS Phase 2 Cycle Energy CE per SAE J2951
- UDDS Phase 2 CO_2
- UDDS Phase 3 Fuel Consumption (gallons/mile)
- UDDS Phase 3 Cycle Energy CE per SAE J2951
- UDDS Phase 3 CO_2
- UDDS Phase 4 Fuel Consumption (gallons/mile)
- UDDS Phase 4 Cycle Energy CE per SAE J2951
- UDDS Phase 4 CO_2
- Highway Fuel Consumption (gallons/mile)
- Highway Cycle Energy CE per SAE J2951
- Highway Phase 4 CO_2
- US06 City Fuel Consumption (gallons/mile)
- US06 City Cycle Energy (joules) CE per SAE J2951
- US06 City CO_2 (gallons/mile)
- US06 Highway Fuel Consumption (gallons/mile)
- US06 Highway Cycle Energy (joules)
- US06 Highway CO_2 (gallons/mile)
- Fuel Type (gasoline 87 AKI, gasoline 91 AKI or premium, diesel, etc.)

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[85] NHTSA, EPA and CARB workshop on technology effectiveness modeling methodologies for the midterm evaluation draft technical assessment report (TAR) analysis for CAFE standards and GHG standards. National Highway Traffic Safety Administration. Accessed September 25, 2016. http://www.nhtsa.gov/Laws+&+Regulations/CAFE+-+Fuel+Economy/nhtsa-epa-carb-workshop-03012016.

- Fuel Net Heating Value (MJ/kg)
- Fuel Carbon Weight Fraction
- Fuel Specific Gravity
- 2025MY Footprint (ft^2)
- Supplemental Tier 3 Catalyst Heating Penalty (joules)
- Supplemental Tier 3 Intake Restriction Loss (joules per phase)
- Supplement Tier 3 Exhaust Backpressure Loss (joules per phase)
- Cycle Electrical Power for Powertrain (joules)
- Incremental Cycle Mechanical and Electrical work for CEGR (joules)

Vehicle Performance Metrics

The Alliance recommends that the Agencies agree on a common set of vehicle performance metrics that include on-road driving. While EPA uses simple 0- 30 mph and 0-60 mph metrics, NHTSA utilizes a more comprehensive set that takes into account actual customer use and acceptance and reflects reasonable trends in the fleet. The Alliance recommends that EPA adopt and utilize the NHSTA set of vehicle performance metrics to avoid inadvertently developing analytic solutions that work for laboratory testing, but do not meet customer requirements. However, the Agencies must both use a more realistic set of performance standards, especially acceleration as NHTSA uses a target of nine seconds. This is not representative of today's fleet and is even inconsistent with the findings in EPA's Fuel Economy Trends Report[86] which states that "since the early 1980's there has been a clear downward trend in 0-60 time."[87] Looking at the acceleration of the top 120 vehicle models sold in 2015 shows the average sales-weighted 0-60 time to be just over seven seconds.[88] Furthermore, we recommend that both Agencies utilize current fleet performance statics, and account for differences between vehicle segments.

Common performance metrics that should be considered are listed here:

- 5% grade at 65 mph top gear
- 3% grade at 75 mph in penultimate gear
- 0 - 60 mph at curb weight
- 0 - 30 mph at GVW acceleration time (turbo lag metric)
- 30 - 50 mph passing
- 60 - 80 mph passing time
- 0 - 60 mph at GVWR
- 60 - 0 mph stopping distance dry pavement

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[86] Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2015, (EPA-420-R-15-016, 2015).
[87] *Id.* at 33.
[88] *Id.* at 33.

- 60 - 0 mph stopping time
- SAE J2807 Trailer Tow Rating for Full Size Trucks and SUV's
- 0 - 60 mph 5500 ft above sea level
- 50 - 70 mph passing at GVW 5500 ft above sea level
- Top gear grade-ability

These metrics must be considered by manufacturers to ensure customer satisfaction and therefore should be considered by the Agencies when modeling future technology packages.

Appendix B: Comments on Technology Specific Effectiveness and Cost

The Alliance provides the following comments on specific technologies described in the Draft TAR. Supplemental comments may be submitted at a later date.

Advanced Atkinson Cycle Engines with CEGR and Cylinder Deactivation (Advanced Atkinson Tech Package)

EPA relies heavily on higher compression ratio, naturally aspirated gasoline engines, operating on the Atkinson thermodynamic cycle (ATK2) for its modeled technology path for MY2025 compliance. Furthermore, this technology is largely used in combination with CEGR and cylinder deactivation (DEAC) technologies.[89] Benefits of this technology pathway are modeled at over a 15% efficiency improvement, on average, relative to the "null" vehicle used by the LPM.

EPA's modeled effectiveness values for the ATK2+CEGR+DEAC pathway (Advanced Atkinson Tech Package) are seriously overestimated. The Alliance has identified the following issues, (described in further detail below): base engine fuel consumption maps are optimistic; practical limitations for CEGR to limit engine knock are not full considered; there is an over-optimistic reliance on the availability of cylinder deactivation at unrealistic speed / load operating points; and the impact of 91 RON market and certification test fuels was not taken into account.

Furthermore, EPA's projected penetration rates are aggressive given that many manufacturers have already started (or are well on their way) down different technology paths, such as turbocharging and downsizing and given the limited time available to develop the technology package described before the MY2022-2025 period.

The Alliance recommends the following:

1. Do not utilize the Advanced Atkinson Tech Package in future analyses until the modeled engine maps (which fundamentally determine technology effectiveness of this package in the Draft TAR) are fully validated using 91 RON fuel (Tier 3 emissions certification test fuel) by dynamometer test results.

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[89] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at ES-10, Table ES-3 and OEMGA model outputs supporting Table 12.33 at 12-29. Higher compression ratio, naturally aspirated Atkinson cycle gasoline engines are modeled at 44% penetration. Approximately 90% of those engines are packaged in combination with cylinder deactivation and CEGR. (Derived from OMEGA model output underlying Draft TAR Table 12.33.)

2. Develop an accurate high-fidelity engine fueling map for the benchmark MY2014 Mazda SkyActiv. Specifically, develop both a dynamometer test data for low load / rpm brake specific fuel consumption (BSFC) data points and a dynamometer test data using 91 RON fuel.

3. Use two fuel surfaces in the vehicle level modeling tools (ALPHA and Autonomie) to accurately model cylinder deactivation use.

4. Consider appropriate penetration caps in the OMEGA and Volpe models to account for the technology pathways that manufacturers are already implementing, and the time necessary to develop a new family of engines based on ATK2 technology as it relates to the timeframe of the rules under discussion.

The Alliance welcomes interaction between the Agencies' and automakers' technical staff to discuss these issues in further detail for the purposes of developing a robust, accurate estimate of the benefits of this potential future technology package to which all stakeholders can agree.

The Modeled Effectiveness of the Advanced Atkinson Tech Package Is Likely Overestimated Due to Multiple Flaws in the Benchmarking and Modeling Approaches Taken by EPA

EPA started the estimate of future Atkinson engine technology benefit with the benchmarking of the United States market version of the 2.0 liter Mazda SkyActiv engine (13:1 CR without CEGR and without cylinder deactivation),[90] as detailed in SAE paper 2016-01-0565.[91] This data was then used to correlate a GT-POWER model. This GT-POWER model was then used to project the operation of a future the engine with the following key changes and additions:

- Increased compression ratio from 13:1 to 14:1 and assumed (without validation) operability on 91 RON fuel
- CEGR
- Cylinder deactivation

A comparison was made between the engine map generated by EPA's benchmarked production 2.0 liter Mazda SkyActiv baseline fuel map that used 96+ RON fuel[92] and an engine map generated by USCAR that benchmarked a similar vintage 2.0 liter SkyActiv engine, but using 91

[90] This is an Atkinson cycle engine in a non-hybrid application, i.e. the EPA "ATK2" technology prior to the addition of CEGR and cylinder deactivation.
[91] Lee, S., Schenk, C., and McDonald, J., "Air Flow Optimization and Calibration in High-Compression-Ratio Naturally Aspirated SI Engines with Cooled-EGR," SAE Technical Paper 2016-01-0565, 2016, doi:10.4271/2016-01-0565.
[92] Advanced Light-Duty Powertrain and Hybrid Analysis (ALPHA) Tool, ALPHA v2.0 Simulation Samples, "engine_2014_mazda_skyactiv_US_201_93AKI_v2." U.S. Environmental Protection Agency. Accessed September 26, 2016. https://www3.epa.gov/otaq/climate/documents/alpha-simulation-samples.zip.

RON fuel.[93] The EPA benchmark fuel map has some areas of concern that cal l into question its use as a baseline for further theoretical additions of technolo gy. The Alliance would welcome the opportunity to work with EPA to understand the discrepancy between the data sets and help rectify any potential issues.

The differences between the USCAR and EPA fuel maps described i n the paragraph above are shown in Figure B-1 below. The green areas in the plot (where EPA projects lower fuel consumption than USCAR) are due to knock limit improvements ass ociated with EPA's use of premium fuel for benchmarking. The octane advantage can clearl y be seen in the comparison, and results in engine fuel map benefits that cannot be achieved with market grade regular and Tier 3 certification test fuels.

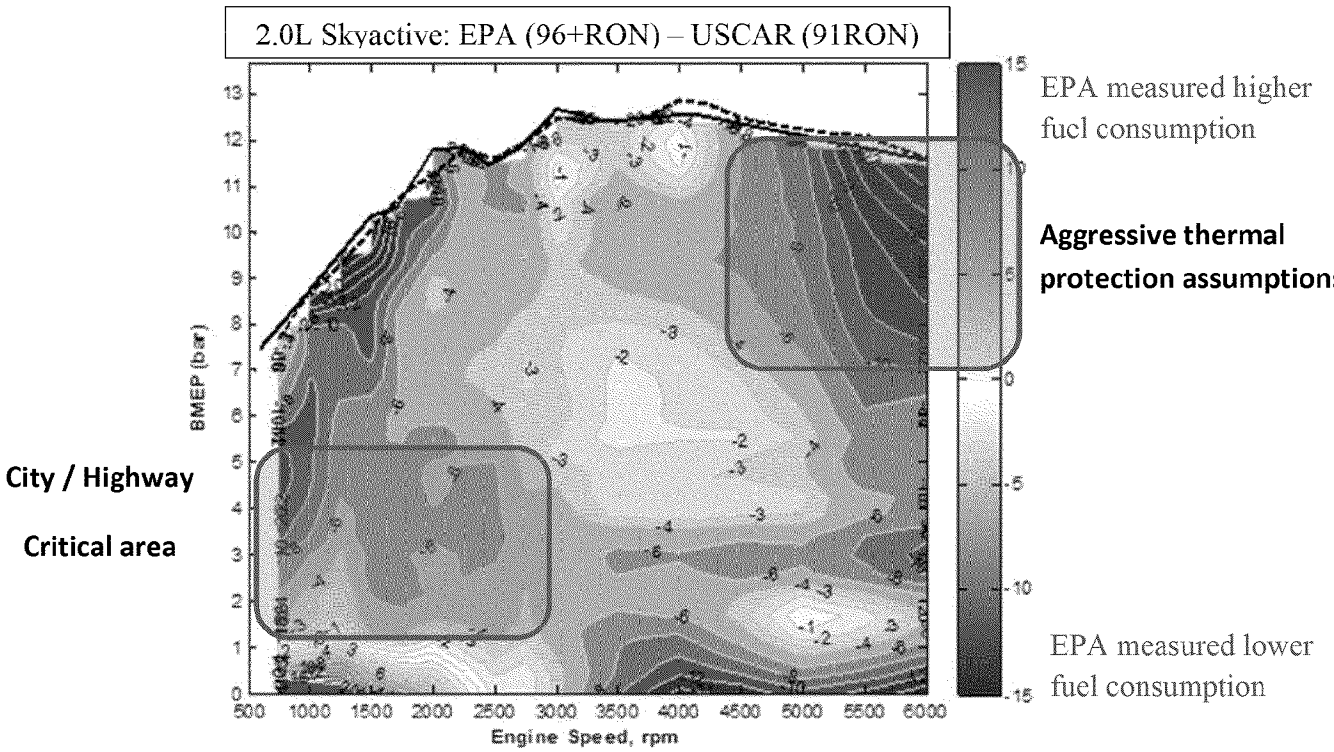

Figure B-1: Comparison of Mazda SkyActiv 2.0 L - EPA Data (96+ RON) vs. USCAR Data (91 RON)

At the speed load points used dur ing the certification cycles, the use of high octane fuel provides a significant benefit relative to the results using 91 RON fuel . Manufacturers cannot realize this benefit as they must protect for on-road operation with 91 RON, and certify with the same.

[93] Courtesy of USCAR.

In developing the engine map used by ALPHA to estimate the benefits of the Advanced Atkinson Tech Package, EPA used the GT-POWER simulation modeling tool. This is an accepted approach by the industry to evaluate new technologies. However, the industry's approach to using GT-POWER results requires extensive calibration and validation, and there are widely recognized limitations that must be taken into account. These include, as mentioned in Appendix A, limitations such as the accuracy of predicting knock, predicting combustion stability, and the ability to accurately reflect control limitations such as cam slew rates.

The GT-POWER modeled benefits of the Advanced Atkinson Tech Package have not been verified by manufacturers or the Agencies, even in an engine dynamometer setting, let alone in a production vehicle designed to meet all regulatory and customer driven requirements. In SAE Paper 2016-01-0565, EPA noted, "[the] BSFC map [of the ATK2 engine] at 14:1 CR [with cooled EGR and cylinder deactivation] could not be validated with engine dynamometer operation, even with use of 96 RON E0 fuel, due to the onset of knock." This result alone suggests EPA's approach is not viable without significant further study and development.

Furthermore, in May 2016, when EPA staff presented the results of their research described in SAE paper 2016-01-0565[94] to a group of advanced engine design and development experts from General Motors, Ford Motor Company and FCA US LLC, plus representatives and engine system experts from the Department of Energy, and four national laboratories (Argonne, Oak Ridge, Sandia, and Pacific Northwest), the industry representatives noted multiple issues that, in their opinion, would make the modeling results "not accurate enough for reference" in the MTE. Issues identified included:[95]

- The model results and experimental results do not match within a range suitable for deriving fuel efficiency benefits over wide range of operations (more specifically, drive cycles).
- There are perceived flaws in some of the qualitative assumptions (over quantitative) used as inputs in the modeling and subsequent validation of the results. The team requested that the complete assumptions for the model be made available for further study.
- Engine performance effects due to realistic limitations associated with knock, Ccooled EGR heat rejection, and effective compression ratio were not considered in detail but will impact overall efficiency gains significantly.

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[94] Lee, S., Schenk, C., and McDonald, J., "Air Flow Optimization and Calibration in High-Compression-Ratio Naturally Aspirated SI Engines with Cooled-EGR," SAE Technical Paper 2016-01-0565, 2016, doi:10.4271/2016-01-0565.

[95] Minutes, United States Council for Automotive Research Advanced Combustion and Emission Control Tech Team Meeting. May 12, 2016. Courtesy of USCAR.

Additionally, it appears that there was a serious clerical error in translating the GT-POWER full load torque data to ALPHA which was then carried into the LPM's calibration. We note that in the SAE paper 2016-01-0565 [96] the GT-POWER model correctly limited the full load torque of the engine due to knock onset. However, it is not clear that this significant reduction in torque was translated to the Advanced Atkinson Tech Package used in ALPHA simulation work which was subsequently used to calibrate the LPM model. This error incorrectly leads to exercising downsizing options because the performance metrics could theoretically be met with the torque that should have been limited as shown in SAE paper 2016-01-0565.[97] The net result is a large overestimation of the benefit with the Advanced Atkinson Tech Package. The modeled performance would be further degraded if correct CEGR assumptions were used as discussed below. Figure B-2 compares the two torque curves, baseline Atkinson, and the Advanced Atkinson Tech Package.

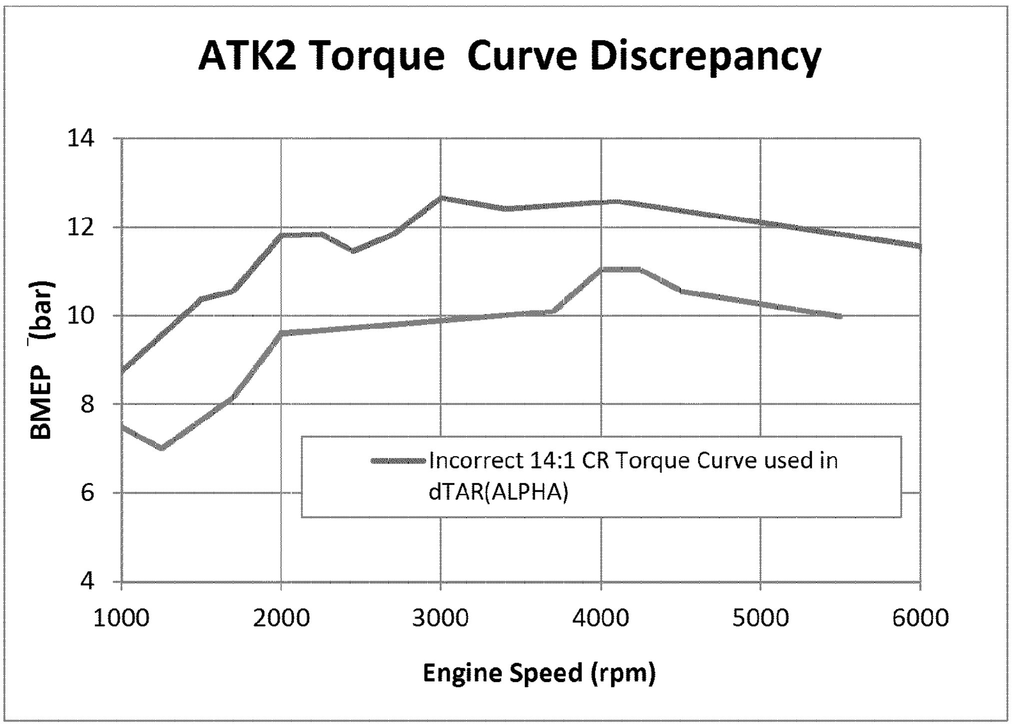

Figure B-2: ATK2 Torque Curve Discrepancy between SAE and ALPHA[98,99]

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[96] Lee, S., Schenk, C., and McDonald, J., "Air Flow Optimization and Calibration in High-Compression-Ratio Naturally Aspirated SI Engines with Cooled-EGR," SAE Technical Paper 2016-01-0565, 2016, doi:10.4271/2016-01-0565.

[97] *Id.*

[98] Process for Generating Engine Fuel Consumption Map (Mazda SKYACTIV 2.0L engine using Tier 2 fuel). U.S. Environmental Protection Agency. Accessed September 26, 2016. https://www3.epa.gov/otaq/climate/documents/2014-mazda-2.0l-skyactiv-13-1-engine-tier-2-fuel-mapping-process-2016-06-20.pdf

There are additional technical concerns with the Advanced Atkin son Tech Package engine map that was part of the Draft TAR ALPHA model sample release. Additional issues which make the engine maps developed from this work questionable include:

- A study of the map and the findings of SAE paper 2016-01-0565 [100] suggest a number of questionable assumptions concerning cylinder deactivation, knoc k, and the late intake valve closing (LIVC) operation.
- Assumptions were vastly simplified with a number of controls is sues surrounding CEGR use which would mitigate much of the final benefit if properly taken into account.
- The Alliance also has concerns with the "in good agreement" model correlation statements cited in SAE paper 2016-01-0565 [101] when the data in the paper shows that the correlation is not within 5% in many of the critical operating areas.

Other prominent issues that should be considered by EPA are listed below:

- A key element of the Advanced Atkinson Tech Package is the long 4-2-1 exhaust manifold, which allows the engine to get all of the exhaust out of each cylinder without pressure pulse interference. How ever, the long exhaust manifol d also moves the catalyst farther downstream of the cylinder head, making it hard to ligh t off quickly to reduce emissions during startup. Additionally, long exhaust manifolds , by definition, prevent a close coupled catalyst strategy, ultimately requiring additional fuel to light off the catalyst during startup.
- The increased heat rejection loading associated with the Advanced Atkinson Tech Package will increase accessory loads.
- The addition of CEGR also impacts implementation of vehicle demand energy improvement technologies such as active grill shutters.
- The complexity in implementing Advanced Atkinson Tech Package p otentially increases durability concerns.

The EPA Modeled Advanced Atkinson Technology Package Penetration Rates Are Not Feasible

For the Draft TAR, EPA modeled that almost every automaker (except Tesla which only produces battery electric vehicl es) will adopt the Advanced Atk inson Tech Package by MY2025 (Figure B-3), and that a number of manufacturers will exceed 50% penetration of this technology

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[99] Lee, S., Schenk, C., and McDonald, J., "Air Flow Optimization and Calibration in High-Compression-Ratio Naturally Aspirated SI Engines with Cooled-EGR," SAE Technical Paper 2016-01-0565, 2016, doi:10.4271/2016-01-0565.
[100] *Id.*
[101] *Id.*

package. Even though Atkinson cycle engines in non-hybrid appl ications have begun to appear in the marketplace, the Alliance does not believe that this high technology penetration is likely or feasible. Even more questionable is the estimate that 40% of th e fleet will have the Advanced Atkinson Tech Package, which has yet to be realized in any production engine.

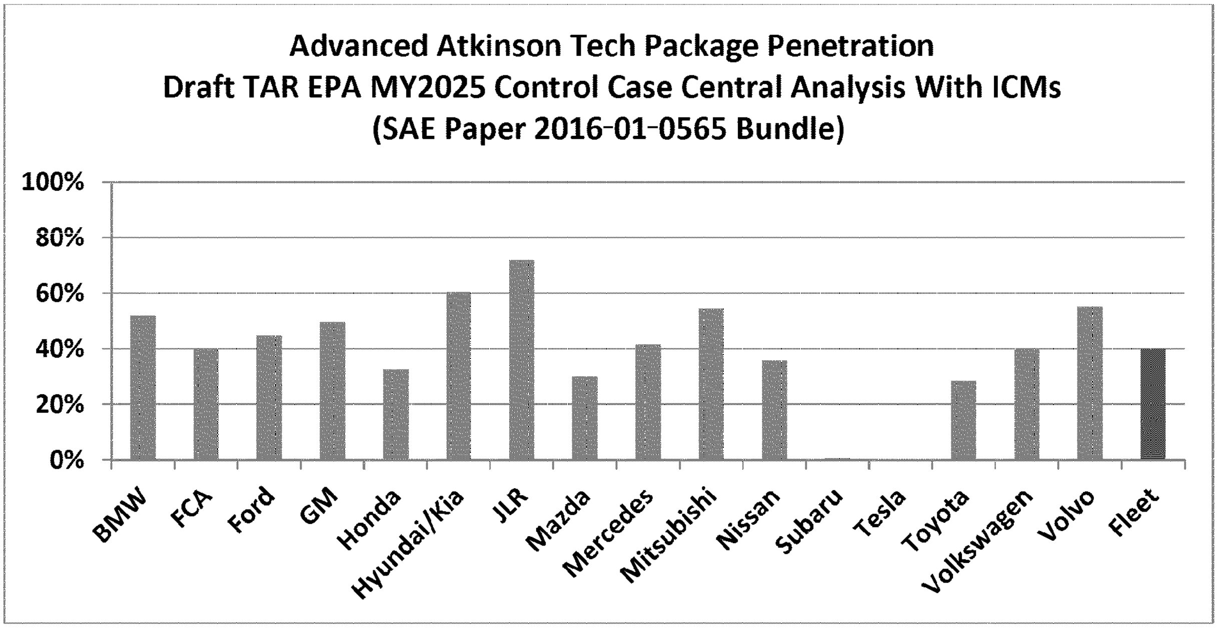

Figure B-3: MY 2025 Advanced Atkinson Tech Package Penetrations in the EPA Control Case Central Analysis with ICMs[102]

The introduction of new engine technology requires many years, as is demonstrated by data in the Fuel Economy Trends Report. [103] For example, gasoline direct injection technology which represented 2.3% of production in MY2008 grew to just over 45%o f expected production for MY2015. It took seven years for a relatively mature technology to reach 45% market penetration. In the case of the Advanced Atkinson Tech Package, even more time will likely be required given that this technology package (as modeled by EPA) has not yet been successfully demonstrated, even in a laboratory.

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[102] Optimization Model for reducing Emissions of Greenhouse gases from Automobiles (OMEGA). OMEGA pre-processor, Technology cost development, and Input/Output files used in the Draft TAR analysis. OMEGA output files for the MY2025 Control Case Central Analysis. U.S. Environmental Protection Agency. Accessed September 26, 2016. https://www3.epa.gov/otaq/climate/documents/omega-tar2016.zip.

[103] "Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2015." Environmental Protection Agency. EPA-420-R-15-016. 2015. Accessed September 17, 2016. https://www3.epa.gov/fueleconomy/fetrends/1975-2015/420r15016.pdf.

Furthermore, it is not reasonable to assume that automakers which have already invested resources and are in the middle of executing strategies based on non-Atkinson technologies (e.g. turbocharging and downsizing) will change strategies completely, or add another major powertrain technology pathway. The additional cost and resource required to execute such a major shift will preclude this option. We commend NHTSA for recognizing this practical resources-based constraint in limiting the application of the Advanced Atkinson Tech Package in the Volpe model.

Additionally, even if automakers choose to pursue an Atkinson cycle based pathway, it is doubtful that virtually all automakers could reach the projected levels in the MY2022-2025 timeframe. There are too few new program opportunities and product plans are likely to already be final for the next several years.

Finally, the level of vehicle integration required to include the elements of the Advanced Atkinson Tech Package pose additional implementation challenges. Not all existing vehicle architectures lend themselves to packaging of the 4-2-1 exhaust manifold. For those vehicles, this requires a revamp of vehicle architectures to integrate this manifold, which significantly increases the implementation timeframe. There are also packaging concerns with CEGR due to the upsizing required for CEGR components for some vehicle segments.

Downsized / Turbocharged Engines

The Alliance agrees with the Agencies' approach of no longer assuming downsizing and turbocharging to the 27 bar level in the Draft TAR. However, we are still concerned that the modeled effectiveness values for turbocharged downsized engines are optimistic. The following key issues are identified and should be corrected. Downstream modeling efforts affected by these changes should also be reassessed prior to further use in the MTE.

- The efficiency of the engine maps used as EPA's basis for boosted engines is too optimistic; use of high octane fuel (instead of the lower octane fuel required for Tier 3 emission testing) and broad over-optimistic friction reduction assumptions contribute to efficiencies we believe are not attainable in practice.
- Both Agencies' effectiveness assumptions are based on 96+ RON test fuel, not the future CAFE/GHG fuel (91 RON Tier 3 / LEV III fuel). However, the Alliance does appreciate NHTSA's assurance that any subsequent testing will use fuel with the appropriate octane level.
- The degree of downsizing posited by the Agencies relies on infinite displacement engines "on the shelf" for automakers and ignores performance and drivability constraints that automakers have to evaluate when considering downsizing.

It is our understanding that the engine fuel maps for downsized , turbocharged gasoline engines were developed by Ricardo for use by the EPA. [104] The Alliance requests that EPA outline its rationale for using an experimental single cylinder engine map as the basis of their analysis of turbocharged downsizing technology rather than using actual production engines that were benchmarked by EPA (Ford 1.6 L Ecoboost and Ford 2.7 L Ecoboost). The Ricardo maps, unchanged since the 2012 FRM, have multiple technical issues wh ich ultimately result in over-optimistic projections of the benefits of this technology.

We believe these fuel maps are based on data with high octane f uel as detailed in the document released during the Draft TAR titled "Process for Generating En gine Fuel Consumption Map: Ricardo Cooled EGR Boost 24-bar Standard car Engine Tier2 Fuel. "[105] The Alliance believes that maps should be developed using the default Tier 3 emission s certification test fuel with 91 RON and these maps should be the basis of EPA's analysis. EPA r egulations require this low octane fuel be used for FE and GHG testing in the MY2022-2025 t imeframe for vehicles that do not require premium fuel. EPA's use of engine maps developed u sing high octane fuel for boosted downsized engine technology in the Draft TAR has resulted in overestimation of effectiveness.

The lower octane of the Tier 3 test fuel degrades efficiency at mid- and high-load conditions because of the need to retard spark due to the onset of knock. Higher-load operation is particularly important because downsized engines will operate m ore frequently at higher loads relative to larger displacement engines.

Figure B-4 demonstrates all the o perating speed / load points o ver the city and highway test cycles from a Ford F150 3.5L GTDI (EcoBoost) engine. The limit ations of regular grade (91 RON) fuel are illustrated by the points above the green mean best torque (MBT) line. To prevent engine damage for these operating points, the combustion phasin g is delayed at the expense of combustion efficiency.

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[104] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 5-283.

[105] Process for Generating Engine Fuel Consumption Map (Ricardo Cooled EGR Boost 24-bar Standard Car Engine Tier 2 Fuel). U.S. Environmental Protection Agency. Accessed September 26, 2016. https://www3.epa.gov/otaq/climate/documents/std-car-egrb-enginemapping-process-2016-06-20.pdf

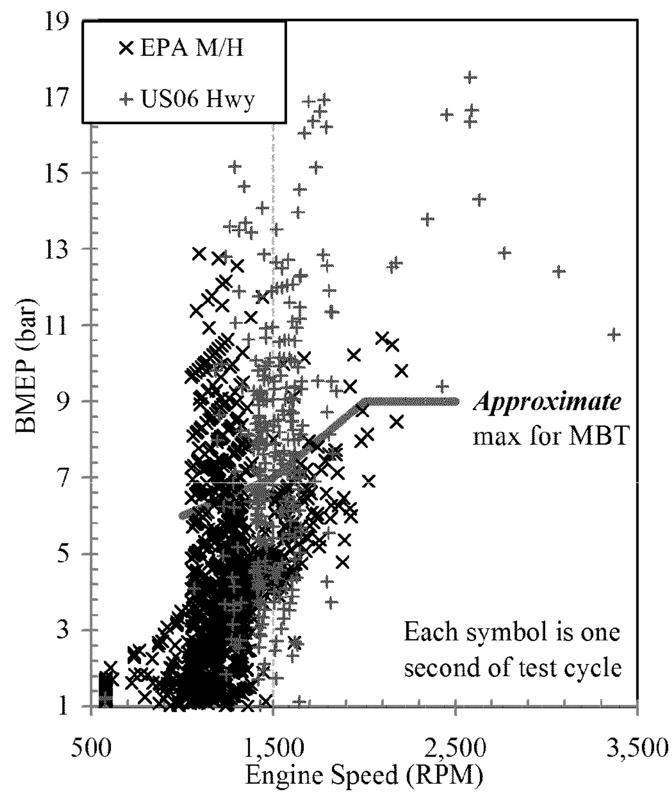

Figure B-4: Speed-Load Points for a Ford F150 3.5L GTDI (EcoBoost) Engine[106]

Fuel octane limitations are further demonstrated in Figure B-5 which shows large impacts on fuel consumption at high-load conditions. Note that with moderate d ownsizing, engine efficiency increases, but aggressive downsizing results in degraded efficiency. This is particularly important because in many cases the Agencies' downsizing assump tions appear to be based on maximizing the efficiency over city and highway test cycles whi le ignoring efficiency reduction during higher-load driving conditions (for example US06 and high-speed interstate driving conditions). Automakers must consider customer drivability and performance acceptance including high-load driving conditions when determining the app ropriate level of downsizing, and cannot implement the level of downsizing based on analysis that is derived solely on operation during certification cycles. Using 91 RON fuel (e.g. Tier 3 fuel) there is no further CO_2 benefit below a displacement-ov er-mass ratio (D/M) of about 0. 9. However, as shown by the 96 RON and 101 RON data in the figure below, the Agency ass umptions based on higher-octane fuel would indicate tha t additional downsizing beyond 0. 9 D/M still yields reductions in CO_2.

[106] Leone, T., Olin, E., Anderson, J., Jung, H. et al., "Effects of Fuel Octane Rating and Ethanol Content on Knock, Fuel Economy, and CO_2 for a Turbocharged DI Engine," SAE Int. J. Fuels Lubr. 7(1):2014, doi:10.4271/2014-01-1228.

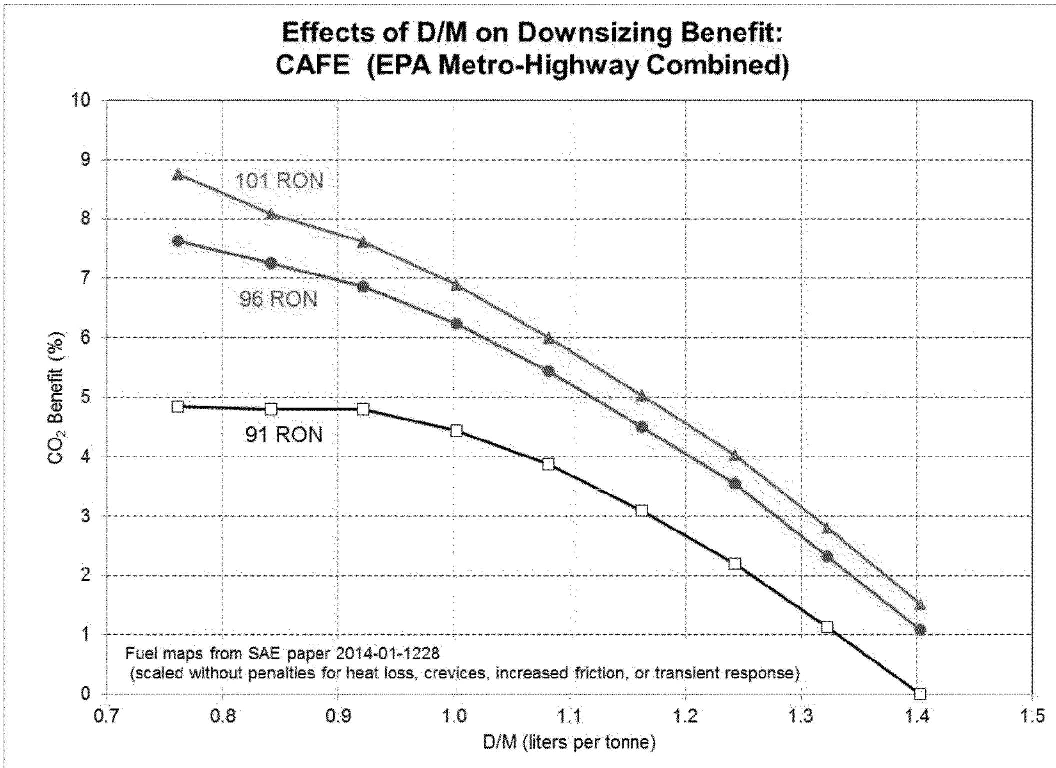

Figure B-5: Effects of D/M on Downsizing Benefit: CAFE Unadjusted Combined Fuel Economy[107]

Even more importantly, Figure B-6 below shows that overestimati ng the degree of downsizing will actually decrease fuel efficiency at higher loads (high-sp eed on-road driving, US06). This effect is amplified with higher octane fuels. The figure shows decreases in CO_2 benefit for engines with a D/M of 1.2 while using 91 RON fuel.

[107] Courtesy of Ford Motor Company. Based on fuel maps from SAE paper 2014-01-1228: Leone, T., Olin, E., Anderson, J., Jung, H. et al., "Effects of Fuel Octane Rating and Ethanol Content on Knock, Fuel Economy, and CO2 for a Turbocharged DI Engine," SAE Int. J. Fuels Lubr. 7(1):2014, doi:10.4271/2014-01-1228.

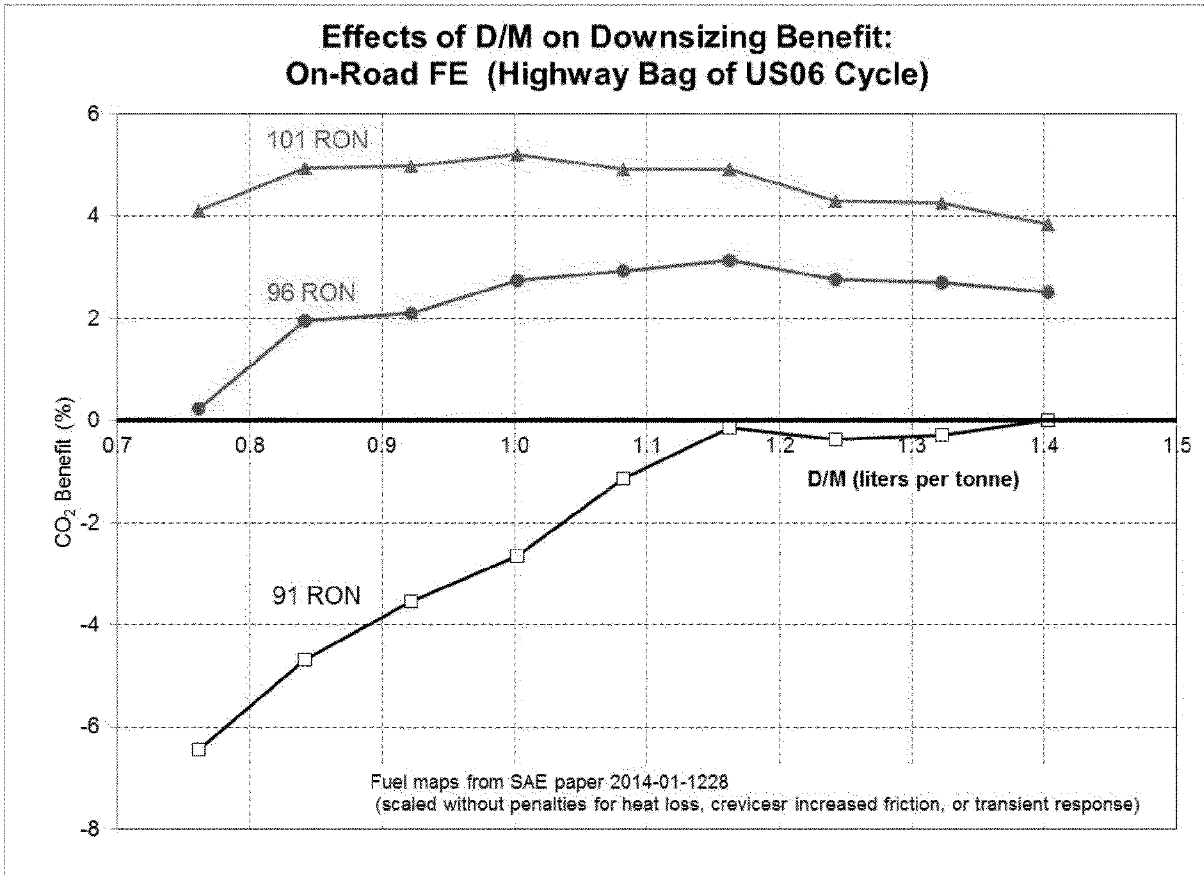

Figure B-6 Effects of D/M on Downsizing Benefit: On-Road Fuel Economy (Highway Bag of US06 Cycle)[108]

The Ricardo analysis assumes ~30 bar BMEP. [109] This is not feasible with 91 RON fuel, even with an advanced boosting system. The Agencies acknowledged th is concern and lowered the BMEP from 27 to 24 bar in the Draft TAR. However, the levels o f CEGR (+25%) assumed with this technology are not practical. The Alliance would welcome a n opportunity to discuss this further to understand the assumptions behind the applicability of high levels of CEGR to 24 bar boosted systems.

Engine downsizing also has signi ficant trade-offs and constrain ts that should have been fully considered, but were not, including:

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[108] *Id.*

[109] Process for Generating Engine Fuel Consumption Map (Ricardo Cooled EGR Boost 24-bar Standard Car Engine Tier 2 Fuel). U.S. Environmental Protection Agency. Accessed September 26, 2016. https://www3.epa.gov/otaq/climate/documents/std-car-egrb-enginemapping-process-2016-06-20.pdf.

- The Ricardo analysis assumed 3.5% benefit from improved engine friction, but downsizing increases cylinder pressures and thermo-mechanical loads, which will actually increase friction.
- There are additional loads such as higher oil pump capacity (fo r piston cooling jets, variable valve trains, turbocharg ers, etc.), larger bearings an d crank pins, heavier pistons with increased ring tension, balance shafts to reduce NVH with reduced numbers of cylinders and greater cooling capacity.
- Ricardo's analysis increased heat transfer losses with downsizing (although the magnitude was not disclosed).[110] However, Ricardo's analysis did not account for increased crevice losses with downsizing, which are significant.[111,112]

Additional concerns with the underlying Ricardo work[113] include:

- Stoichiometric operation was assumed based on a paper by Schmuc k-Soldan et al., [114] which featured an engine with 9.2:1 CR and high octane (95 RON) fuel. The results of the paper were extrapolated to a 10.5 CR with lower octane (91 RON) fuel. The Ricardo analysis[115] did not properly account for US06 test cycle and on-road emissions / enrichment constraints, essentially increasing CR and reducing octane at the same time.
- Higher BMEP requires more than just higher boost pressure – hig h octane fuel is a key enabler.[116]

It is also not clear that the effect of CEGR requirements at full load were considered by Ricardo[117] when combustion phasing limits were evaluated. Full load comb ustion phasing *limits* the compression ratio, so cooled EGR would be required *at full load.* This is constrained by boost system capability, vehicle heat rejection capacity, compr essor outlet temperature limits

[110] *Id.*
[111] *See* Smith, P. and Cheng, W., "Assessing the Loss Mechanisms Associated with Engine Downsizing, Boosting and Compression Ratio Change," SAE Technical Paper 2013-01-0929, 2013, doi:10.4271/2013-01-0929.
[112] *See* Smith, P., Cheng, W., and Heywood, J., "Crevice Volume Effect on Spark Ignition Engine Efficiency," SAE Technical Paper 2014-01-2602, 2014, doi:10.4271/2014-01-2602.
[113] Process for Generating Engine Fuel Consumption Map (Ricardo Cooled EGR Boost 24-bar Standard Car Engine Tier 2 Fuel). U.S. Environmental Protection Agency. Accessed September 26, 2016. https://www3.epa.gov/otaq/climate/documents/std-car-cgrb-enginemapping-process-2016-06-20.pdf.
[114] Schmuck-Soldan et al., "Two Stage Boosting of Spark Ignition Engines" (Internationales Wiener Motorensymposium 2011).
[115] Process for Generating Engine Fuel Consumption Map (Ricardo Cooled EGR Boost 24-bar Standard Car Engine Tier 2 Fuel). U.S. Environmental Protection Agency. Accessed September 26, 2016.
[116] Leone, T., Olin, E., Anderson, J., Jung, H. et al., "Effects of Fuel Octane Rating and Ethanol Content on Knock, Fuel Economy, and CO2 for a Turbocharged DI Engine," SAE Int. J. Fuels Lubr. 7(1):2014, doi:10.4271/2014-01-1228.
[117] Process for Generating Engine Fuel Consumption Map (Ricardo Cooled EGR Boost 24-bar Standard Car Engine Tier 2 Fuel). U.S. Environmental Protection Agency. Accessed September 26, 2016.

(due to coking), engine transient response, and component sizing and cost. If boost is used for EGR, it limits the maximum BMEP and downsizing.

For further information, please see the attached "Limitations of Ricardo Fuel Economy Analysis of Downsizing" presentation.[118]

Industry "Rightsizing" of Downsized Turbocharged Engines

The direction of automakers has been towards moderate downsizing of boosted engines. Early examples of more aggressive downsizing, such as the Ford 2.0L Ecoboost engine and Audi 1.8L, were met with low customer acceptance and were subsequently replaced with more appropriately downsized engines (2.3L in the case of Ford, and 2.0L in the case of Audi[119]).

Summary

Downsizing is constrained by many factors including:

- Regulatory compliance (city and highway cycles) is not improved with more downsizing beyond a certain point when designing for 91 RON fuel.
- Efficiency during on-road high load operation does not improve beyond a certain level of downsizing, and can actually decrease if downsizing is too aggressive. This effect is further amplified with the use of regular grade octane fuel.
- Higher BMEP combustion phasing requires lower compression ratio and / or high octane fuel.
- Enrichment and emissions control for on-road high speed / high acceleration will negatively impact downsizing efforts.
- Transient response limitations, including shift schedule effects will negatively impact the benefits of downsizing.

The Alliance believes that the benefits of turbocharging and downsizing were overestimated by EPA primarily because of the following reasons:

- Downsizing benefits were extrapolated beyond reasonable D/M ratios.
- Fuel maps were not developed with future compliance test fuels and market fuels (Tier 3 91 RON).
- The modeled engine maps did not account for crevice losses, higher friction, and lower compression ratio.

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[118] Attached as Attachment 7. Presentation courtesy of Ford Motor Company.
[119] *See* Audi presentation from Internationales Wiener Motorensymposium 2015, which describes the 1.8L engine being "rightsized" back to 2.0L.

- Benefits of CEGR were overestimated given implementation constraints such as higher accessory loads and heat rejection.
- It appears that the effectiveness levels of cylinder deactivation, when applied to downsized boosted engine technology with CEGR, are too high.

The Alliance would welcome an opportunity to discuss this further to understand the assumptions used.

Advanced Transmissions

The Alliance disagrees with the Agencies' treatment of transmissions in Chapter 5 of the Draft TAR. The issues are summarized below:

- Fundamentally different transmission technologies, such as continuously variable transmissions (CVTs), dual clutch transmissions (DCTs) and planetary) were lumped into bundles and were assigned identical efficiencies by the EPA.
- We do not agree with EPA's estimates of the absolute effectiveness of TRX11 and TRX21.
- We do not agree with the level of benefits cited by EPA in adopting high efficiency gearboxes (HEG2) elements on TRX11 and TRX21 transmissions.
- The relative improvements expected by upgrading transmissions from TRX11 to TRX22 are overstated.

Transmissions continue to provide a critical source for continuing improvements in CO_2 reduction and improved FE. As noted in the Draft TAR, automakers have already achieved significant penetration rates of advanced transmissions into the fleet and have increased gear count from 4-, 5-, and 6-speeds up to 7-, 8-, 9- and even 10-speeds. While other transmission technologies such as CVTs are also experiencing strong growth, we expect conventional automatic transmissions to remain the primary transmission technologies through MY2025 and beyond.

Moving forward, the primary focus for additional improvements to transmissions will continue to include the balance of FE optimization and meeting the full array of vehicle functional requirements and customer expectations. It is important that the Agencies remain sensitive to customer feedback regarding shift comfort for transmissions. Dual clutch transmissions, once expected by the 2012 FRM to become the leading technology, have generally failed to achieve market acceptance in the United States due to ongoing customer concerns with feel and comfort. Early generation 9-speed transmissions experienced significant product launch issues due to customer satisfaction with shift feel. Even newer generation CVTs have had to adopt features to improve driving experience, or in some cases even mimic the feel of an automatic transmission, in order to meet customer expectations. While many of these issues have since been improved, any new customer issues that appear may require alterations tha t could detract from the expected FE benefit.

Significant investments have been made to continue the developm ent and improvement of 8+ gear wide ratio transmissions. Current generation wide ratio t ransmission architectures are generally expected to carry thr ough MY2025 and include many of the following technical features:

- Improving efficiency through bearing, seal, oil level, and oil distribution optimization.
- Torque converter technology has changed to reduce lock-up speeds and improve NVH.
- Improved matching of engine and electrified propulsion system technologies to the transmission portfolio.

The effectiveness values attributed to the transmissions used b y EPA are overly optimistic compared to the actual benefit provided by vehicles with wide r atio transmissions introduced by the automakers. Additionally, the Alliance also did not find ev idence that suggests that the Agencies accounted for packaging these transmissions in existing or future vehicle architectures.

Estimates of the Absolute Effectiveness of TRX11 and TRX21

The Agencies estimated the absolute effectiveness of TRX11 tran smissions based on a GM six-speed transmission from the 2013 Malibu.[120] Relative to a null transmission on a null engine, the Agencies estimated that TRX11 transmissions deliver 5.5-7.5% improvement depending on vehicle size.[121] The Alliance believes that thes e effectiveness improvement est imates by the Agencies are unobtainable.

We cannot quantify which technologies are overestimated because of EPA's binning methodology, which does not recognize unique efficiencies of different transmission technologies. Going forward, the Alliance recommends EPA harmon ize with NHTSA on this point. The Alliance would welcome the opportunity to work with EPA to provide a technically accurate way of modeling the benefit of vastly different and emerging transmission technologies.

We also recommend that EPA aba ndon the confusing nomenclature a dopted in the Draft TAR and specifically identify the transmissions and the unique technology associated with the transmissions.

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[120] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 5-297.
[121] *Id.* at 5-298.

Marginal Improvements Due to HEG2

The EPA expects that transmissions mapped to both the TRX11 and TRX21 designations "can be improved to a level that would bring the transmission effectiveness to the efficiency level" of the TRX12 or TRX22. Manufacturers anticipate challenges in attempting to implement those efficiency improvements.

The EPA estimates average marginal improvements in effectiveness due to adoption of high efficiency gearbox level 2 technologies (HEG2) of 4.2 percentage points for TRX11/12, and 2.7 percentage points for TRX21/22.[122] The Alliance disagrees with these estimates primarily because this loss area has already been in development and optimization for several decades (many current designs of existing gears are already at high efficiency). Additionally, the theoretical efficiency gains are offset by automakers' needs to balance efficiency against noise, durability, and packaging.

The EPA's reliance on the ALPHA model and information in SAE papers to model the effect of adding HEG2 to TRX21[123] is particularly problematic. For example, FCA US LLC (F recently introduced an upgraded 8-speed rear-wheel drive transmission. Upgrades to this transmission include: the introduction of clutch separator springs to reduce clutch drag, a reduction in oil pressure, and improved hydraulic efficiency in the solenoid and valve body.

Some of these elements are similar to the HEG2 elements referred to in the Draft TAR. The CO_2 benefit with these actions was approximately 0.8% unadjusted combined FE. We acknowledge that the gear ratios did not change between first and second generation transmissions, and that this is contrary to EPA's expectation with HEG2 transmissions. However, FCA has indicated that modeling using wider spread ratios reveals that there is no improvement in CO_2 once the transmission is adjusted to adequately protect for shift "busyness" and feel.

As the Alliance described in earlier comments, a number of shortcomings undermine the ALPHA model and its outputs. The process in which individual improvements are picked from SAE papers suffer from similar issues, where many small errors across analyses compound into a significant disconnect from manufacturer expectations.

Improvements Due to Deployment of TRX22 Relative to TRX11

In upgrading transmissions from TRX11 to TRX22, the Agencies believe that a "9.7% improvement in effectiveness is achievable."[124] Supporting this view, the EPA contends that

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[122] *Id.* at 5-298.
[123] *Id.* at 5-298.
[124] *Id.* at 5-298.

"most transmissions can gain 6-10 percent from efficiency improvements alone."[125] While such improvements may be theoretically possible, improvements in efficiency from upgrades more typically fall in the range of 1%-2%. Overall, manufacturers expect that moving from TRX11 to TRX22 will deliver effectiveness improvements in that range of 1%-2% due to relentless market-driven requirements for durability, noise, and packaging.

Transmission Modeling in ALPHA

EPA's standard car ALPHA simulation samples include two 6-speed to 8-speed HEG1 transmission walks, one using GM Ecotec and the other with Mazda SkyActiv engine, each showing 9.0% and 8.6% CO_2 reduction effectiveness, respectively. Industry modeling indicates that a maximum of 4% effectiveness can be achieved from 6-speed to 8-speed HEG1 transmission upgrade. The 4.6%-5.0% discrepancy can be attributed to the four bins listed below based on modeling work done using both EPA's ALPHA tool and verifying the results with industry's modeling tools. The four bins are: lock-up assumptions, torque converter lock-up efficiency, engine downsizing methodology, and transmission models and modeling. Some of the issues identified during this verification are listed below.

EPA uses third gear lockup for both 6-speed and 8-speed transmissions. This assumption gives the 8-speed an advantage since it allows the 8-speed transmission to lock up at lower vehicle speed. It should be noted that EPA's 8-speed model has 4th gear ratio about equal to the 6-speed transmission's 3rd gear ratio. The proper assumption here is 4th gear lock-up for the 8-speed transmission. This accounts for an estimated for 0.3%-0.8% of the effectiveness discrepancy.

ALPHA transmission walks have torque converter lock-up efficiency modeled as 98.5% for 6-speed and 99.5% for 8-speed. This assumption is invalid unless this indicates next generation torque converter technology with 8-speed transmissions. In the HEG1 6-speed to HEG1 8-speed walk done by EPA the high efficiency assumption is misleading and instead should use common torque converter efficiency. Using the common 98.5% converter lock-up efficiency in ALPHA simulation shows that 0.6% of the effectiveness discrepancy is due to this assumption.

In the Draft TAR, the EPA methodology uses matching 0-30 mph and 0-60 mph times in vehicle powertrain configuration walks. For the 6-speed to 8-speed ALPHA transmission walk, EPA downsized the engine by approximately 10% and shows that replacing 6-speed with 8-speed should result in equal performance even with the smaller engine. This methodology, however, fails to consider other important vehicle attributes that are strictly related to engine's power capability. For example, industry estimates that this would degrade a standard vehicle's top gear 75 mph grade-ability by more than 10%, thus effectively taking the downsizing option away.

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[125] *Id.* at 5-298.

Keeping the same engine, the ALPHA transmission walk shows that this methodology accounts for 1.4%-2.0% of the effectiveness discrepancy.

Lastly, industry modelers applied the baseline 6-speed (GM 6T40) and 8-speed data (ZF 8HP45/RE) in ALPHA and found that 1.0%-1.8% of the discrepancy is due to differences in transmission models and modeling. To verify EPA's transmission modeling approach, the industry would like to request that EPA clarify the modeling assumptions specifically related to transmission inertia modeling and how the conversion of rear wheel drive (RWD) to front wheel drive (FWD) of FCA's 8HP45 transmission was modeled.

Based on the concerns on EPA's transmission modeling, the industry recommends that EPA take the following actions:

- Use a common ratio lockup in same generation (HEG1) transmissions.
- Use common lockup efficiencies in the same generation (HEG1) transmissions.
- Add grade-ability metrics. In general, we recommend that EPA recognize all needed performance metrics in its analysis to ensure commercially saleable packages.

Additionally, we have questions on the following EPA transmission modeling assumptions:

- Why do the 6-speed transmissions have common gear inertias?
- Why are 8HP45 transmission gear inertias so small?
- What do the input and output inertias represent?
- Can EPA provide a detailed explanation on how they modeled the 8HP45 RWD to FWD data conversion?
- What is included in the HEG2 package?
- Does the following list of enablers complete EPA's assumptions for HEG2 package, and what effectiveness values are assigned to each of these enablers?
    - 2nd gear lockup
    - Lock-up efficiency improvement
    - Spin loss reduction
    - Pump loss reduction
    - Gearbox ratio optimization with increased span (8.7 span 8HP)

For further details of this analysis and the specific quantitative analysis, please see the attached presentation at Attachment 8.

Packaging Concerns

The Alliance did not find evidence that suggests that the Agencies considered packaging of these transmissions in existing or future vehicle architectures. Packaging is challenging, particularly for FWD transmissions which have the final drives inside the transmissions. In general, RWD transmissions tend to be long and smaller in diameter while FWD transmissions tend to be shorter and have a large diameter. In order to take a RWD architecture and put it into a FWD vehicle (as was assumed in EPA's conversion of the FCA 8HP45 RWD transmission to a FWD architecture), manufacturers must double stack the clutches radially, which leads to larger diameter clutches. This adds significantly to spin losses becau se (spin losses scale to the cube of radius. Additionally, the churni ng losses are relatively more i n FWD transmissions as compared to RWD transmissions, as the clutches are immersed deeper in the oil. EPA should have accounted for these packaging constraints and trade-offs when projecting efficiencies for transmissions.

CVT Transmissions

The Agencies expect large efficiency improvements for CVT trans missions, increasing from 85% efficient to as much as 94% efficient in 2025. The EPA also expects that vehicles currently operating with CVT transmissions can increase to TRX21 with an accompanying 6% improvement in effectiveness. [126] However, the Alliance foresees much smaller improvements from upgrades to CVT transmissions. The assumption that CVTs cu rrently operate at 85% efficiency is proper, but the method for improvement assumed by the Agencies is not described. CVTs already include the technologies listed to improve efficie ncy generally associated with TRX21. Clamping load is a significant requirement for CVT design and durability. A single slip can damage the CVT enough to require replacement of the entire CVT, and that need for reliability and warranty on behalf of the customer could limit the ability to substantially improve losses of the CVT.

48V Mild Hybrid

There are three main concerns regarding the Agencies' assumptio ns for mild hybrid technology: effectiveness, cost, and market penetration. The Agencies have presented very different interpretations of the costs, e ffectiveness, and market penetra tions of mild hybrid technology both from each other, and from the 2012 FRM. In 2012, the Agen cies based their cost and effectiveness values on a tear down study performed by FEV GmbH for EPA and battery costs from Argonne National Laboratory's (ANL) BatPaC model. [127] The 2012 FRM fleet projections relied heavily on the use of mild hybrids for fleet compliance and assumed that for MY2025 26% of the fleet would need this technology to comply (and up to 49 % for certain manufacturers). Since 2012, the Agencies have not completed any further teardow n studies on this technology, which has also not yet achieved a significant market share as p redicted, but appear to have worked closely with suppliers to update the cost and effectiven ess values. As a result, the Draft TAR, shows a significant decrease in the projected cost of this technology and increased effectiveness. The Agencies continue to view mild hybrids as a technology integral to compliance and now predict 18% of the fleet will need mild hybr id technology, while some

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[126] Id. at 5-299.
[127] 77 Fed. Reg. 62966 (Oct. 15, 2012).

manufacturers will now require this technology on nearly 75% of their fleet.[128] Whether or not mild hybrid technology sees high market penetration in the future depends not only on customer acceptance, but also on whether or not the Agencies properly understand and credit this technology.

Effectiveness and Cost

In 2012, EPA and NHTSA considered the cost and benefit of high voltage mild hybrid technology. In the Draft TAR, two different configurations of mild hybrid systems are now being considered by the Agencies: 48V Belt Integrated Starter Generator systems (BISG) and Crank Integrated Starter Generator systems (CISG). BISG systems typically have lower electric machine power (and therefore have lower effectiveness) and are less costly than CISG. In its analysis, EPA only considered BISG as a technology option, while NHTSA considered both BISG and CISG. In general, the Agencies comment that the new 48V systems have a more favorable cost-versus-effectiveness trade-off when compared to 115V systems. While there is some cost savings associated with stepping down the voltage from 115V to 48V, in general, the Alliance believes the Agencies are still greatly underestimating the cost of both BISG and CISG systems.

The Alliance attempted to draw a direct comparison of the Agencies' costs and effectiveness estimates to understand how each technology was used in the separate modeling work done by each Agency. In some cases, not all of the information was available in the Draft TAR, but the effort was made to directly compare the mild hybrid assumptions using the following assumptions:

1. The cost and effectiveness of improved accessories "IACC1, IACC2" were included.
2. The cost and effectiveness of electric power steering "EPS" were excluded.

Tables B-1 and B-2 below show a comparison of the assumptions used by the Agencies for the BISG system for both a standard passenger car and truck.

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[128] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 12-29, Table 12.33.

Table B-1: BISG Medium/Standard Car Comparison[129]

	Effectiveness	Electric Machine kW	Direct Manufacturing Cost	
			MY2017	MY2025
NHTSA	12.9%	7 kW	$917	$717
EPA	9.4%	12 kW	$704	$565

Table B-2: BISG Truck Comparison[129]

	Effectiveness	Electric Machine kW	Direct Manufacturing Cost	
			MY2017	MY2025
NHTSA	10.9%	Not provided	$1,181	$924
EPA	7.1%	12 kW	$704	$565

In 2012, the Agencies used an effectiveness value of 7.3% for "high voltage" mild hybrids, Table B-1 and B-2 show a significant increase in effectiveness in the Draft TAR. In comparing Tables B-1 and B-2, significant differences in the EPA and NHTSA Draft TAR assumptions for the BISG systems can also be seen. First, the NHTSA effectiveness is 37% and 54% higher than assumed by EPA for the car and truck examples respectively, and both are higher than in 2012. Second, the cost assumed by NHTSA is higher than that of EPA, which does correlate with the higher effectiveness. However, the difference in assumed electric machine power rating does not correlate with either the cost or effectiveness differences. The Agencies need to re-evaluate the correct costs and effectiveness that should be applied for BISG and CISG, as opposed to simply merging the two tables. This should be done in a collaborative manner where automaker input is considered, not just that of suppliers who do not have to integrate parts into complete vehicles or be concerned with compliance requirements which may limit their understanding of the total cost and task of increasing levels of technology in vehicles today.

In addition, the CAR Powertrain Study shows that a survey of automobile manufacturers found that for a medium size car, the average MY2017 cost is $1,388 and effectiveness is 8.8% to go from the baseline configuration to a 48V system.[130] This industry average shows a lower

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[129] *Id.* at 5-302; 5-302, Table 5.85; 5-306, Table 5.89; 5-355, Table 5.124; 5.426, Table 5.183; 5/453, Table 5.207; 5-521.

[130] "An Assessment of Powertrain Technology Costs Associated with Meeting CAFE and GHG Standards." Center for Automotive Research. 2016. 13.

effectiveness than assumed by the Agencies and a significantly higher cost than the highest of the Agencies' estimates.

Finally, NHTSA assumes a different BISG system cost for a car versus a truck, which is a trend with which the Alliance agreesand supports.

As noted earlier, EPA does not consider a CISG system as a technology option in their fleet compliance modeling analysis while NHTSA does. However, the EPA does provide in the Draft TAR assumptions for the effectiveness of a CISG system. Tables B-3 and B-4 below compare Agency assumptions where data is available data for a car and truck example.

Table B-3: CISG Medium/Standard Car Comparison[129]

	Effectiveness	Electric Machine kW	Direct Manufacturing Cost	
			MY2017	MY2025
NHTSA	19.0%	15 kW	$2,588	$1538
EPA	15.0%	20 kW	Not provided	

Table B-4: CISG Truck Comparison[129]

	Effectiveness	Electric Machine kW	Direct Manufacturing Cost	
			MY2017	MY2025
NHTSA	14.0%	Not provided	$3,198	$1,905
EPA	12.2%	20 kW	Not provided	

As with the BISG system, the NHTSA assumptions for effectiveness are greater than those of EPA; 27% and 15% for the car and truck examples, respectively. In addition, NHTSA assumes a higher learning factor for the CISG system than they do for the BISG system, which results in a significantly greater cost reduction over time for the CISG system. The learning factors used by NHTSA in particular are problematic and extremely low for CISG. For CISG, the Agency predicts a 20% greater reduction in costs in MY2025, compared to the case for strong hybrids. It is not clear why NHTSA assumed such a learning curve is the case and the Alliance believes this decision should be revisited.

As is the case for many fuel efficiency technologies, mild hybrids do not simply "bolt on" to provide reductions; they affect nearly every system on a vehicle which makes the true cost much greater than just the direct manufacturing cost price of the motor, belt, and larger battery. In addition to the costs of the mild hybrid technology itself, automakers must consider many competing technical constraints. It may be the case that the suppliers from which the Agencies obtained their cost data failed to consider these issues. The following list points to OEM technical concerns that must be addressed to maintain customer satisfaction:

- Mitigation may be needed to reduce engine shutdown torque pulses with BISG.
- Robust engine position parking is required.
- Robust engine starts must account for NVH concerns.
- Increased belt tension may be needed to provide repeatable torque (especially for part throttle assist and regeneration maneuvers).
- Increased belt pulley ribs may be necessary. (Eight to ten rib belts could cause increased accessory drive friction)
- BISG strategy may require adjustment for light tip-ins and to prevent transmission downshifting.
- BISG battery regeneration strategy could change with battery durability concerns.
- When activating cylinder deactivation, there is not an unlimited amount of energy available to improve "fly zone" NVH operation.
- These technologies could include additional mass that is not taken into account.
- There are still concerns over belt life and maintenance.

Market Penetration

As the Agencies have noted, market uptake of hybrid technology has not grown as was expected, but has dropped by 23% since its peak market penetration in MY2010. This may have been due to low fuel prices as well as other factors.[131] With the shift from 115V to 48V systems, the cost of these systems will decrease as the Agencies note, which could make the payback for customers more attractive. These modeled savings, however, might not translate to the customer due to overly optimistic cost projections. There are still further challenges for the automakers when trying to reach the large market penetrations for this technology predicted by the Agencies for the MY22-25 timeframe.

Although customers will see benefits from this system in real-world driving conditions, all of this benefit is not realized by the on-cycle test procedures. This significantly impacts the fuel-reduction-versus-cost-ratio that manufacturers must optimize when selecting technologies to implement to meet the regulatory standards. While the current stop-start table credit attempts to address this gap, there are three reasons that a mild hybrid will result in a higher off-cycle benefit than captured with the current stop-start table value:

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[131] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 3-13.

1. Idle fraction off-cycle is much higher in the real world than on-cycle, as shown in the Daimler start-stop petition.[132] Similarly, the fraction of stops per vehicle mile travelled (VMT) is higher in the real world than on the combined cycle.
2. Since the fraction of stops per VMT are higher in the real world than on the combined cycle, the greater "stop related" Mild hybrids benefits should be recognized. Mild Hybrids can have a greater "window" of engine off operation including launch (or torque) assist due, in part, to opportunity regeneration, than stop-start systems alone.
3. Mild hybrid systems enable engine-off coasting (sailing) during real-world city and highway driving conditions that are not captured on-cycle.

The Agencies should consider a rev ised adjustment factor, or of f-cycle credit value, to account for these benefits. Due to the significant off-cycle potential that mild hybrids provide, simply adding a credit for mild hybrids to the existing off-cycle program with table caps is not reasonable. There are three options to consider. Option one w ould be to eliminate the table caps to ensure the off-cycle benefits of all future technologies are fully recognized for the real-world fuel consumption reduction they p rovide. Option two would be t o increase the table credit cap. Finally, option three would be to exclude mild hybrid technologies from the cap calculation. It is important that all technologies that provide additional off-cyc le fuel savings be recognized to promote implementation of these technologies by manufacturers. In addition, it is equally important that manufacturers have a defined value for these credits to allow for product planning. If a table value or adjustment factor is not defined during the planning phase, technologies may be excluded due to uncertainty a nd risk. This could lead to hi gher cost solutions that the market may not be able to support.

Power Split vs. P2 Hybrids

The Draft TAR analysis considers both power-split and P2 hybrid s simply as "strong hybrids" with identical cost and effectiveness assumptions. This simplif ication discounts the fundamental architectural differences between these two technologies, which have different packaging requirements, efficiency potentia ls, and vehicle applications. The Alliance recommends that EPA develop separate cost and effectiveness projections for power-split and P2 hybrids.

Separate Battery Costs and Technology Discussion

The Alliance has concerns with some of the battery-related assu mptions the Agencies have made in the Draft TAR. However, it is not possible to complete a thorough evaluation of the discussions surrounding batteries in the 60-day timeframe. Some initial feedback for the

[132] Light Duty Greenhouse Gas Standards Compliance Information. Requests for Off-Cycle Credits - Merecedes-Benz. U.S. Environmental Protection Agency. Accessed September 26, 2016. https://www3.epa.gov/otaq/regs/ld-hwy/greenhouse/ld-ghg.htm.

Agencies is to ensure costs assumptions are not just for energy cells, and to present what size the system is relative to cost, as there are economies of scale and large battery system costs can be different from those for mild or even strong hybrids used by the automotive industry. Further, it may be more appropriate for the Agencies to use different cost metrics for mild hybrids reflecting different usage and requirements for these systems.

In addition, while there may be some learning for battery manufacturers, there are also many tradeoffs with this technology that will require extensive research and development (R&D) which must be considered especially for any new and yet to be discovered chemistries, cooling methods, or additional safety concepts.

Finally, in determining the average range characteristic of BEVs for MY2014 used in the development of the baseline and/or reference fleet, the Agencies simply did a sales-weighted average to arrive at a value of 155.5 miles. [133] However, the data used suggests this may not be the most appropriate way to calculate this value because some 77% of the listed models have ranges of less than 87 miles. It is only when considering Tesla vehicles with ranges of 200 or 270 miles that the average increases to 155.5 miles. Further work should be done to consider the most appropriate way to determine the average range characteristics of the fleet for use in development of the reference and/or baseline fleet.

Octane - The Missed Powertrain Technology Option

The Agencies tested some engine technologies (e.g. downsized turbocharged engines) on high octane Tier 2 certification fuel. The Alliance has commented that re-assessment of certain engine technologies on Tier 3 certification fuel is necessary to arrive at an accurate assessment of fuel economy and GHG benefits given that the use of Tier 3 certification fuel is mandated during the timeframe discussed in the Draft TAR. That said, it is unfortunate that the Agencies did not include octane as a technology analogous to powertrain technology options they did study.

Government agencies worldwide, including the United States, are requiring aggressive improvements in vehicle fuel economy and greenhouse gas emissions. Achieving these improvements will be challenging, and will require significant changes in all aspects of vehicle design, including changes to engines and transmissions. In meeting this challenge, engine efficiency improvements are being implemented on all new light-duty vehicles. These efficiency improvements include higher compression ratio engines, engine displacement downsizing, turbocharging, down-speeding, and hybridization.

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[133] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 4-47,Table 4.35.

The co-design of fuels and engines is an important pathway to improve fuel economy in spark ignition gasoline engines. The widespread availability of higher octane rated gasoline (having increased knock resistance) is a key enabler for the next phase of advanced engines expected to occupy a large fraction of the vehicle fleet. In addition, the implementation of higher octane rated gasoline in the marketplace could be a cost-effective means of immediately improving fuel economy across a substantial portion of the existing light-duty vehicle fleet.

Auto manufacturers support bringing high octane fuels to market that are aligned with future engine technologies and vehicles that are designed and optimized to take full advantage of the performance qualities of those fuels.

Automakers oppose the sale in any U.S. jurisdiction of so-called sub-grade gasoline (<87AKI [Anti-Knock Index]) regardless of altitude, climate or artifacts of use allowed in ASTM 4814. Such fuel degrades performance for the current fleet and constrains manufacturers' ability to design prospective engine technology that can improve engine and fuel efficiency toward better fuel economy and reduced GHG.

Strategies need to be implemented to avoid using sub-standard octane in an engine optimally designed for a high octane fuel that will result in decreased fuel economy and performance, and could possibly result in engine damage. Thus, it is imperative that customers use the proper fuel for which their vehicles are designed.

The widespread introduction of newly designed engines into the market is dependent not only on the universal availability of the requisite high octane fuel, but also the assurance that high octane fuel will be the fuel of choice for the customer. Action is needed to ensure higher octane fuel will enable smaller higher compression engines that could require additional anti-knock protection to accommodate new engine technologies.

Mass Reduction

The methods and data chosen by the Agencies to predict mass reduction strategies and cost curves have led to overly optimistic projections. The Alliance believes that mass reduction is a viable pathway for improving fuel economy and CO_2 emissions, albeit at a higher cost and with likely longer lead-times than projected by either Agency. Using a materials-based approach, identifying real world constraints, correctly evaluating current vehicle baselines, and further considering the "mass-add-back" likely needed for future regulatory and customer requirements would help to correct the over-optimistic projections. The Alliance seeks to work with the Agencies at identifying mass reduction pathways and establishing more representative costs of mass reduction.

Real World Complexity

The Agencies, in their analysis of mass reduction pathways and the associated costs, do not fully account for significant real-world complexity. This is not to say that mass reduction is not possible, merely more expensive and perhaps requiring more time than clean-sheet studies would indicate absent real-world constraints. These real world constraints, as explained in a recent CAR research paper [134] (attached as Attachment 9) include: "how new materials and processes are developed; physical facility infrastructure constraints; requirements for globally competitive supply chains; proliferation of global platforms; customer acceptance and the need to constantly improve ride and handling; and product development processes (and resources) that are not designed to optimize vehicles specifically for fuel economy." [135] The paper continues to note "[i]t is broadly acknowledged that the realized cost may be significantly higher than the idealized analyses."[136] We caution the Agencies to apply good engineering judgement if they continue to rely on "clean sheet" analyses as the basis for determining mass reduction strategies and costs.

Tear Down Studies of Non-Optimized Vehicle Designs

The Alliance agrees with a recent 2015 National Academies of Science report where it recommends that mass reduction the teardown be augmented with materials-based studies: "The committee recommends that the Agencies augment their current work with a materials-based approach that looks across the fleet to better define opportunities and costs for implementing lightweighting techniques…"[137]

The Agencies largely used three teardown studies to develop mass reduction pathways and cost curves. The results of these three teardown studies have been published (Venza,[138] Accord[139] and the 2011 MY Silverado[140]) and a fourth study is still in peer review (2014 MY Silverado).[141] Today's fleet is well past the technology used in the first three vehicles.

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[134] "Identifying Real World Barriers to Implementing Lightweighting Technologies and Challenges in Estimating the Increase in Costs." Center for Automotive Research. 2016.
[135] *Id.* at 18.
[136] *Id.* at 18.
[137] "Cost, Effectiveness and Deployment of Fuel Economy Technologies for Light-Duty Vehicles." National Academy of Sciences, National Research Council to the National Academies. 2015. 12.
[138] "Light-Duty Vehicle Mass Reduction and Cost Analysis – Midsize Crossover Utility Vehicle." U.S. Environmental Protection Agency. EPA-420-R-12-026. 2012. Accessed September 26, 2016. https://www3.epa.gov/otaq/climate/documents/420r12026.pdf.
[139] "Mass Reduction for Light-Duty Vehicles for Model Years 2017-2025." National Highway Traffic Safety Administration. 2012. Accessed September 26, 2016. ftp://ftp.nhtsa.dot.gov/CAFE/2017-25_Final/811666.pdf.
[140] "Mass Reduction and Cost Analysis – Light-Duty Pickup Truck Model Years 2020-2025." U.S. Environmental Protection Agency. EPA-420-R-15-006. 2015. Accessed September 26, 2016. https://www3.epa.gov/otaq/climate/documents/mte/420r15006.pdf.

The 2011MY Silverado was built off of the GMT900 platform that was launched in 2006. The GMT900 was itself designed from the GMT800 platform that was launched in 1998. Even though material was substituted in the 2006 redesign, the architecture was not optimized for mass reduction. By using the MY2011 Silverado, the EPA essentially over-projects the mass reduction opportunities compared to the more recently optimized platforms.

Similarly, the Toyota Venza is not a current state-of-art Toyota design. The Venza was not a mass optimized design and included significant content from the Toyota Highlander and Camry. Also, the Venza analyzed by EPA was designed for two engines. The EPA analysis examined the Venza model with the smaller of the two engines. The Venza mass reduction study would therefore be optimized for one engine and not take into account the broader utility of the Venza with the larger engine. The Venza study contains the two fundamental issues of starting with a non-optimized vehicle and ignoring the full range utility of the Venza. This leads to an overly optimistic evaluation of low cost mass reduction pathways compared to optimized vehicle designs that must account for all the applications of a given platform.

The Honda Accord study performed by EDAG GmbH for NTHSA[142] and the MY2014 Silverado study[143] may more accurately portray mass reduction pathways and possible associated costs. While industry generally agrees with the potential pathways explored in the Honda Accord study, we believe the EDAG cost curve, Figure B-7, should be updated to reflect Honda feedback and recent CAR findings.[144] CAR findings include the need for several adjustments to the EDAG cost curve including: adjusting the baseline to reflect the current state of technology, accounting for barriers to implementation, recognizing less mass de-compounding may be actually realized, and providing for "mass add-back."

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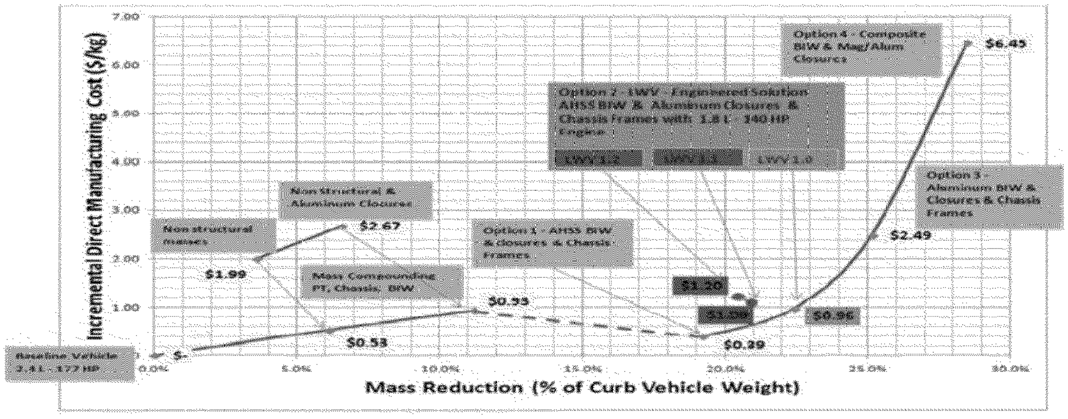
141 Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 5-168.

142 "Mass Reduction for Light-Duty Vehicles for Model Years 2017-2025." National Highway Traffic Safety Administration. 2012. Accessed September 26, 2016. ftp://ftp.nhtsa.dot.gov/CAFE/2017-25_Final/811666.pdf.

143 Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 5-168.

144 "Assessing the Fleet-Wide Material Technology and Costs to Lightweight Vehicles." Center for Automotive Research. 2016.



Source: EDAG Honda Accord MY2011 study, Singh, Harry. (2012, August)

Figure B-7: EDAG Cost Curve

While the Alliance does not yet have final cost curves based on the all the recommended adjustments, we expect the new baseline and "mass add-back" wil l effectively push the curve to the left on the x axis above. Furthermore, real-world barriers and less realized mass de-compounding will result in steeper cost curve and/or push the cost curve further to the left.

In summary, concerns with the Agency mass reduction analyses in clude: insufficient attention paid to real world manufacturer c onstraints, the need to includ e "mass add-back", baseline issues, and tear down analysis including dated or non-optimized vehicle designs all used to establish optimistic cost curves. The Alliance and its members look forward to working with the Agencies in developing cost curv es that are more reflective of the current and near-term state of the industry.

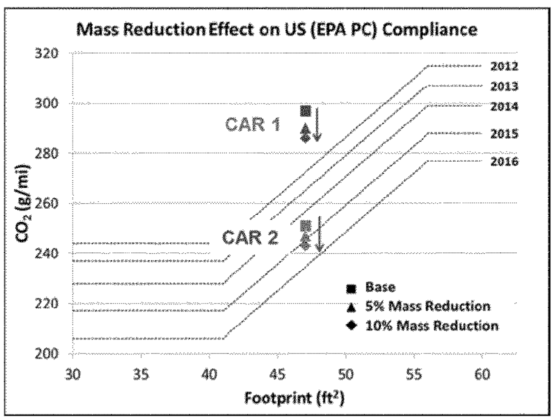
Mass Reduction Has Different Impacts in Other Regulatory Structures

The Agencies have noted mass reduction is a viable option for improving fuel economy. Manufactures agree, but face constraints. It is important to n ote that, of the major markets, only the U.S. has a footprint-based GHG and FE regulatory structure. Many countries have mass-based regulatory structures as show in Table B-5.

Table B-5: Compliance Attributes

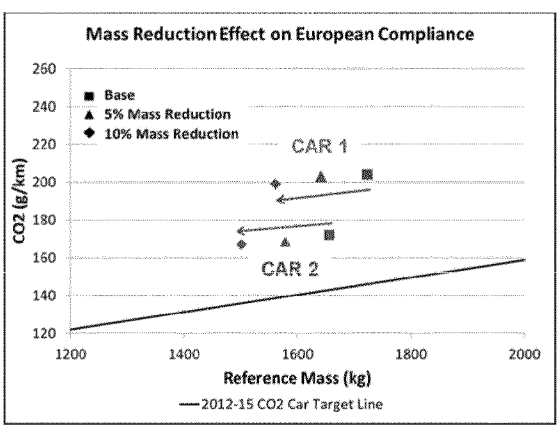
	United States	Europe	China	Brazil
Compliance Method	Fleet Average	Fleet Average EU28+Norway+Iceland (Switzerland specific fleet)	Fleet Average & Per Vehicle Limits	Fleet Average
Attribute	Footprint	Mass	Mass	Mass

The regulatory structure matters because mass reductions to vehicles in other markets contribute significantly less to an automaker's regulatory compliance as illustrated below. It would be helpful to understand the Agencies' perspective on this issue and the need for volume application of technologies to minimize costs as depicted in Figures B-7 and B-8. Minimizing costs improves customer acceptance and thereby realizes environmental improvement.



Mass reduction impacts compliance in the U.S. footprint based system.

Figure B-8: Mass Reduction Effect on US Compliance



Mass reduction has significantly less impact in the EU's mass based system.

Figure B-8: Mass Reduction Effect on European Compliance

Aerodynamic Load Reduction

EPA and NHTSA have pursued different paths for defining the initial aerodynamic state of the vehicles in their baseline fleets. EPA used methodology from Novation Analytics where frontal area is calculated from vehicle and tire dimensions, and the drag coefficient (C_d) is mathematically derived from coastdown data.[145] NHTSA simply relied on manufacturer-reported data.

As an example of the difference in results, EPA defines a 3.6L Chrysler 300 as having a C_d of 0.332 with a frontal area of 26.02 ft^2. NHTSA reports the same vehicle as having a C_d of 0.318 with a frontal area of 25.8 ft^2. This represents a 5% difference in the product of Cd and frontal area (C_dA).

Regardless of what was calculated, EPA gave no credit for vehicles that were already aerodynamically improved. This means that all vehicles in their analysis are considered candidates for up to 20% more aerodynamic improvement.

NHTSA pursued a more sophisticated approach. This included defining an average C_d for nine vehicle types (sedan, coupe, minivan, hatchback, convertible, wagon, SUV, van, and pickup) and specifying a vehicle as "AERO10" or "AERO20" if that vehicle's C_d was 10% or 20% below average for its type.[146]

Of the two methods, we support NHTSA's methodology with the following suggestions:

1. As the Draft TAR is intended as a review of the MY2017-2025 rulemaking, which in turn was based on MY2008 and MY2010 fleets, the average Cd values for the various vehicle types should also be derived from MY2008 or MY2010 vehicles. By comparing to older vehicles, the progress that manufacturers have made with respect to the vehicles used in the rulemaking will be properly reflected. If the Agencies continually compare a vehicle's present status against the fleet's present status, manufacturers will never achieve the 10% or 20% aerodynamic improvements called for by the Agencies' models.

2. Using older vehicles as recommended above may necessitate using Novation Analytics' methodology for defining C_d and frontal area since the data used to calculate the parameters is still readily available. While this method is empirical, it has the advantage

[145] *See* "Technical Analysis of Vehicle Load Reduction Potential For Advanced Clean Cars" ControlTec, LLC. 2015. Docket ID EPA-HQ-OAR-2015-0827-0153.
[146] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 4-62, Table 4.55.

of being consistent for all vehicles and avoids the variations in facilities and methodology with which manufacturers measure C_d.

3. NHTSA's method of calculating an average C_d and then multiplying by 0.9 or 0.8 to achieve a target C_d for AERO10 and AERO20, respectively, is mathematically convenient but disconnected from the data they report. For example, the pickup class of vehicles shows an average C_d of 0.395, which is 10% and 20% less than that average yields targets of 0.355 and 0.316 for AERO10 and AERO20. Both of these targets are lower than the best C_d reported by any manufacturer, suggesting that the targets may be infeasible. Instead of considering every vehicle as a candidate for a 20% aerodynamic improvement, a more realistic limit may be the best-in-class 90th percentile value. This was the level used by Novation Analytics for their work for CARB.[147] Along with this suggestion, the Agencies should also consider reducing the step size from 10% to 5%. This will provide greater resolution in the results and also avoid the possibility of having to stop at 10% if 15% is the maximum feasible limit.

4. NHTSA's method for analyzing baseline aerodynamics requires that a manufacturer achieve 10% better than average C_d for a vehicle to be considered AERO10. That vehicle would remain AERO10 until 20% better than average was attained. A more just approach would be to have 10% as the center of the range instead of the start of the range. For example, an AERO10 vehicle should be any vehicle that is 5% to 15% better than average. This is consistent with NHTSA's method for mass reduction where a vehicle is considered to have 5% mass reduction (MR1) for the range of 3.75% to 5.625% below trend.

Plausibility for EPA Application of Aerodynamic Improvements

Within the OMEGA technology package outputs for the MY2025 control case central analysis, EPA applies AERO2 (20% aerodynamic load reduction) to approximately 93% of the modeled MY2025 fleet.[148] Given the issues identified in establishing the baseline aerodynamic improvements[149] and sound engineering practice, it makes sense to provide a check for the plausibility of achieving 20% aerodynamic improvements across such a wide range of vehicles.

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[147] "Technical Analysis of Vehicle Load Reduction Potential For Advanced Clean Cars" ControlTec, LLC. 2015. 34.
[148] Optimization Model for reducing Emissions of Greenhouse gases from Automobiles (OMEGA). OMEGA pre-processor, Technology cost development, and Input/Output files used in the Draft TAR analysis. OMEGA output files for the MY2025 Control Case Central Analysis. U.S. Environmental Protection Agency. Accessed September 26, 2016. https://www3.epa.gov/otaq/climate/documents/omega-tar2016.zip.
[149] See Appendix C in these comments, describing Alliance concerns that EPA has assumed that no vehicles in the 2014MY baseline had any aerodynamic improvements.

As described by the Agencies in the Draft TAR (Section 5.2.5.1), there are generally two components of aerodynamic load for a vehicle--the frontal area and coefficient of drag. Reducing either component will minimize the effective aerodynamic load experienced by a vehicle. Vehicle frontal area can be modified by changing a vehicle's overall height and/or width, but reducing either by a significant amount would likely impact interior passenger space. Assuming that EPA is not suggesting significant body dimensional changes (which would not be in the spirit of maintaining current vehicle performance), the modeled improvements in aerodynamic resistance must therefore be based primarily on improvements in the coefficient of drag.[150]

As a rough check of the plausibility of achieving 20% aerodynamic improvements across nearly the entire MY2025 control fleet, the Alliance makes a simple comparison of the resulting coefficients of drag in the MY2025 control fleet to a present vehicle with generally accepted superior aerodynamic performance. The following steps were performed:

1. Determined MY2025 control fleet vehicles to which the Aero2 technology is applied by examining OMEGA model outputs.
2. Applied a 20% reduction to the coefficient of drag reported in the EPA "2014MY Baseline with Tech and Market Tabs for Docket"[151] for each of the vehicles with Aero2 technology applied in the MY2025 control fleet.
3. Compared the resulting improved drag coefficients to a MY2014 baseline vehicle as a proxy test for plausibility.
4. Identified examples which did not appear reasonable.

The Tesla Model S was the MY2014 vehicle chosen for comparison to the modeled MY2025 vehicles with 20% aerodynamic drag reduction. The Tesla Model S is broadly accepted as one of the most aerodynamic vehicles available in the 2014 model year.[152,153] Furthermore, because of its design as a battery electric vehicle sports sedan, the Model S includes a number of passive aerodynamic features including an aerodynamic body design, full underbody panel (the battery), relatively low ground clearance, and door handles which are completely flush to the body when not in use. The Tesla Model S design also passively implements features for which a

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[150] This assumption is further supported by Draft TAR p. 5-145 et seq. Section 5.2.5.3.1 which primarily focuses on recent vehicle changes which impacted the coefficient of drag with limited discussion of frontal area modifications.
[151] Docket ID EPA-HQ-OAR-2015-0827-0402.
[152] *See* 10 of the Sleekest Cars on the Road. The Cheat Sheet. Accessed September 7, 2016. http://www.cheatsheet.com/automobiles/wave-of-the-future-10-of-the-sleekest-cars-on-the-road.html/?a=viewall.
[153] *See* 12 of the Most Aerodynamic Cars in Production Right Now. Motorburn. Accessed September 7, 2016. http://motorburn.com/2014/01/12-of-the-most-aerodynamic-cars-in-production-right-now/.

conventional vehicle would generally require active implementation—such as grill shutters.[154] Many of these features can be seen in Figure B-9.

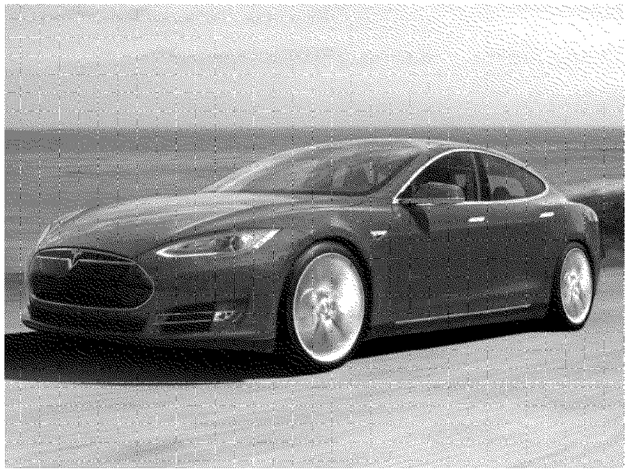

Figure B-9: 2014 MY Tesla Model S

When 20% aerodynamic drag reductions are applied to the MY2025 control fleet as modeled by EPA and then compared to the MY2014 Tesla Model S, approximately 54% of all modeled MY2025 vehicles have a coefficient of drag equal to or better than the MY2014 Tesla Model S. A closer review of these results reveals several vehicles which would not seem to be plausibly able to improve coefficients of drag to the degree required without significant changes to the vehicle design and resulting functionality. For example, multiple large future SUVs such as the Nissan Armada[155] (Figure B-10) have coefficients of drag equivalent to the present Tesla Model S. Additional examples exist of large SUVs becoming better than the Tesla Model S such as the GMC Yukon Denali[156] (Figure B-11). A visual comparison of these vehicle types to the Tesla Model S suggests that regardless of the number of passive and aerodynamic features added, the likelihood of achieving Tesla Model S drag coefficients appears low.

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[154] Active grill shutters seal the front grill radiator opening on conventional internal combustion engine (ICE) vehicles. In contrast, the Model S front end is generally closed off already in its design because a large radiator for an ICE is not needed.

[155] Optimization Model for reducing Emissions of Greenhouse gases from Automobiles (OMEGA). OMEGA pre-processor, Technology cost development, and Input/Output files used in the Draft TAR analysis. OMEGA output files for the MY2025 Control Case Central Analysis. U.S. Environmental Protection Agency. Accessed September 26, 2016. https://www3.epa.gov/otaq/climate/documents/omega-tar2016.zip. OMEGA vehicle index numbers 1721-1728

[156] *Id.*, OMEGA vehicle index number 1076.

Figure B-10: 2014 MY Nissan Armada

Figure B-11: 2014 MY GMC Yukon Denali

This simple comparison of estimated future drag coefficients to an exemplar MY2014 vehicle demonstrates why a robust plausibility check of modeled future aerodynamic improvements must be performed. The Alliance recommends that the Agencies develop such a plausibility check before the next step of the MTE and apply the check to all vehicles with modeled aerodynamic improvements.[157] Such a check should consider, but is not limited to, type of vehicle and aerodynamic improvements already implemented for the specific vehicle. The Agencies should also consider the vehicle functional requirements (e.g. off-road capability) in determining the types of aerodynamic improvements that could reasonably be applied.

Tire Rolling Resistance

While the Draft TAR is optimistic that concerns about wet traction and durability of low rolling resistance tires can be resolved, the 2015 NAS Report[158] was more realistic in noting that these problems continue to present engineering challenges. This is also reflected in the preliminary

[157] *See* Appendix A of thse comments for further discussion on other recommended plaubility checks.
[158] "Cost, Effectiveness and Deployment of Fuel Economy Technologies for Light-Duty Vehicles." National Academy of Sciences, National Research Council to the National Academies. 2015. 242.

and limited data from the Transport Canada/Natural Resources Canada study shown in Draft TAR Figure 5.47.[159] While one tire with low rolling resistance and good wet traction was noted, the overall trend shows that wet traction cannot be ignored, and that there may be limits on how much overall reduction the industry can achieve.

Impact Analysis

The Alliance performed an analysis to demonstrate the impact the identified issues in EPA's vehicle-level simulations can have on fleet level compliance. The analysis revealed that the net cumulative effect is, at minimum, 20 g CO_2/mile for the average car and 30 g CO_2/mile for the average truck from over-estimating the effectiveness of multiple technologies such as the Advanced Atkinson Technology Package, downsized boosted engines, HEG transmissions, overlooking the impact of regulatory mandates like EPA's tier 3 compliance and 1 mg/mi PM compliance. These differences equate to multiple years of stringency. There are additional issues, not covered in the analysis which would lead to an even greater effectiveness gap, including modeling application errors, CREE deterioration factors, and other issues.

Given the magnitude of the projected shortfall for conventional vehicles, the only remaining technologies available to automakers that meet or exceed the MY 2025 standards are electrified products. The Alliance disagrees with the Agencies' conclusion that the MY2022-2025 standards can be met largely with more efficient non-hybrid conventional powered cars at the costs stated in the Draft TAR.

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[159] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 5-156.

Appendix C: Baseline Fleet Development

A critical step in modeling the technologies (and associated costs) required to bring the future light-duty fleet into compliance with the MY2022-2025 standards is an accurate understanding of the technologies already in use on today's vehicles. Knowledge of the technologies already in use prevents "double counting" of technologies' costs and benefits as noted by EPA.[160] Errors in this step of the process can ultimately result in underestimating the penetration of more advanced technologies required for compliance and the costs for doing so. They can also lead to implausible applications of additional levels of technology.

The Alliance has identified several issues in the Agencies' development of their respective baseline fleets which we believe will ultimately result in significant errors in the assessment of the technologies required for compliance in the future, if left uncorrected. These issues are described in detail below.

Additional issues with the baseline fleets developed for the Draft TAR may be identified at a later time. We note that in creating two separate baseline fleets (MY2014 for EPA and MY2015 for NHTSA), the Agencies have doubled the workload required for stakeholders to review the data and processes associated with the baseline fleet assessment. Therefore, only a preliminary review of this critical step could be completed in the timeframe alloted for these comments.

Selection of Baseline Model Year

In the Draft TAR, the Agencies chose different model years for their analysis–MY2014 (EPA) and MY2015 (NHTSA). The Alliance supports the use of the most recent data available in establishing the baseline fleet, and therefore believes that NHTSA's selection was more appropriate for the Draft TAR.

We support both Agencies' intent to use the most recent data available for the analysis which will inform the next step of the MTE. We urge EPA to consider aligning with NHTSA to the more recent model year for which GHG and FE data on a vehicle-level basis is available. We note that final model year data must be submitted within 90 days after the end of the model year.[161] We recommend that the next step of the MTE process (assuming CY2017) be timed to allow both Agencies to utilize MY2016 final data. Such alignment would result in greater consistency between the Agencies' respective assessments, would capture the latest technology

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[160] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 4-1.
[161] 40 CFR § 600.512-12.

information available in the present fleet, and would ease the burden on stakeholders reviewing future baseline assessments.

Determination of Baseline Mass Reduction

In the Draft TAR, at Sections 4.2.10.1 (NHTSA)[162] and 5.3.4.6.2 (EPA)[163], the Agencies describe their efforts to estimate the level of mass reduction in existence in their respective baseline fleets. The Alliance agrees that determining the existing level of vehicle mass reduction technologies already applied is a critical step to ensure that the projected future level of mass reduction applied is feasible and practicable, and that the costs of such future mass reduction are appropriately taken into account. However, neither of the Agencies' approaches fully consider, nor properly account for, mass reduction technologies applied in their respective baseline fleets.

Mass Reduction Measures Already Implemented

A key issue in determining the feasible and practicable level of mass reduction potential for any given vehicle, and the costs associated with that mass reduction, is the degree of design optimization and lightweight material application already applied to that vehicle.

Manufacturers have already added significant mass reduction technologies. A recent study by the Center for Automotive Research [164] investigated mass reduction strategies and the degree of mass reduction technology already applied by nine manufacturers for vehicles representing nearly 50% of the new vehicle market. Every vehicle surveyed contained a higher level of mass reduction technology (e.g. use of high-strength steels and/or aluminum) than the 2011 Honda Accord and 2011 Chevrolet Silverado used to establish the mass reduction cost curves in the 2012 FRM. [165,166] In fact, the study found that some of the vehicles have already applied advanced high-strength steels (AHSS) to the point described as Option 1 (AHSS body-in-white (BIW) & closures & chassis frames) noted in the 2011 Honda Accord study.[167] At the time the CAR study was begun, the NHTSA 2014 Silverado study was not publicly available, so no comparison was made. The Alliance may consider requesting that CAR provide additional analysis relative to the 2014 Silverado study to inform supplementary comments after the close of the Draft TAR comment period.

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[162] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 4-65 et seq.
[163] *Id.* at 5-394 et seq.
[164] "Assessing the Fleet-Wide Technology and Costs to Lightweight Vehices." Center for Automotive Research. 2016.
[165] *Id.* at 22.
[166] *Id.* at 24.
[167] *Id.* at 35.

Consideration of Mass Reduction Design and Technologies Applied Without Concurrent Curb Weight Reductions

Although manufacturers have already engaged in significant application of advanced high-strength steels, aluminum, and other lightweight materials, not all of the improvements have resulted in net mass reduction. The reason for this is that there are many other additional features desired (and in many cases expected) by automotive customers which add mass, thereby reducing the observed benefits of mass reduction technologies. Nonetheless, manufacturers still have already applied additional mass reduction technologies upon which the mass reduction cost curves are premised.

The Alliance agrees with the premise that mass reduction technologies do not provide the expected GHG and FE benefits when other mass additions offset their benefits. However, it is wholly inaccurate not to account for added mass reduction technologies in terms of the overall cost to add the next stage of mass reduction technology. The concept underlying the mass reduction cost curves is that added technologies will increase cost, typically commensurate with the types of material and designs selected. Not accounting for the actual level of mass reduction technology already implemented on specific vehicles leads to underestimation of future vehicle costs.

The Agencies have approached this issue in two ways. EPA has provided direct offsets for a limited number of changes which increase mass relative to the baseline vehicles (mass associated with safety technology and increases in vehicle footprint). NHTSA has approached this issue on a statistical basis similar to that taken in a recent vehicle load reduction study by ControlTec, LLC (ControlTec Load Reduction Study).[168] Both of these approaches have positive and negative aspects. The EPA approach provides direct accounting for some mass increases, but fails to consider other potential mass increases which could result in underestimation of the level of technology already applied. The NHTSA approach assumes that any vehicle with less than the best demonstrated curb weight has potential for improvement, but the approach still does not adequately capture the degree to which mass reduction technologies have already been applied.

The Alliance's concerns can be demonstrated with a simple example. The Ford F150 pickup truck was redesigned for MY2015 and incorporates an aluminum-intensive BIW, advanced highstrength steel frame, and secondary mass reductions including engine downsizing. This level of mass reduction technology is generally described on the Agencies' light-duty truck direct manufacturing cost curve as the AHSS + AL Solution (LWV), which is shown at

[168] "Technical Analysis of Vehicle Load Reduction Potential for Advanced Clean Cars." ControlTec, LLC. 2015. Docket ID EPA-HQ-OAR-2015-0827-0153.

approximately 17-18% mass reduction.[169] However, the EPA process suggests only a 14% reduction relative to the cost curve was achieved by the redesigned Ford F150.[170] The NHTSA process similarly understates the degree of mass reduction technology applied with an estimate of only 10% mass reduction technology applied (level "MR3").[171] Although this is just a single example, we believe it is probable that many more vehicles are subject to the same issues based on the Agencies' processes for determining the level of mass reduction present in the baseline fleet. The process (or processes) to estimate baseline mass reduction must be improved prior to the proposed determination and proposed rulemaking.

Comments on the EPA Approach to Baseline Mass Reduction

The EPA approach to determining baseline mass reduction for the purposes of adjusting vehicle placement on the Agency-developed cost curves can be broadly described as being based on a percentage mass reduction observed for a particular vehicle in the MY2014 baseline fleet versus. its 2008 counterpart. There are several flaws to this approach. This approach assumes that no mass reduction activity occurred for any vehicle prior to the 2008 baseline relative to the study vehicles upon which the mass reduction cost curves are based. Another flaw is that manufacturers may have applied mass reduction technologies (therefore moving to the right on the estimated cost curve), but reductions were used to add other customer-desired features.

Lack of Analysis of Mass Reduction Technologies Applied in the 2008 Model Year Fleet

EPA describes that in the 2012 FRM, it was assumed that the MY2008 baseline fleet had zero mass reduction, and that for the Draft TAR, mass reduction is defined as a decrease in curb weight, relative to MY2008.[172] Although this is a convenient assumption to make, this approach fails to consider that it is quite likely that there was a distribution of vehicle mass reduction technologies around those considered as the zero mass reduction technology point on the estimated cost curves. (If, in fact, the mass reduction cost curves are relative to a null vehicle, then all vehicles in the MY2008 fleet would have mass reduction applied relative to the 0% point of the cost curves.) By treating all MY2008 vehicles as an average vehicle (or ignoring that all vehicles are likely to have improved past the null state), EPA, at minimum, underestimates the mass reduction starting point for many, if not all vehicles. The consequence of this is that the cost of projected mass reductions will be increased relative to the current projection (each pound of mass reduction is expected to have a higher incremental cost than the previous). In addition,

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[169] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 5-384 and 5-426.
[170] *Id.* at 5-165, 5-398. Mass reduction of 13% shown in Table 5.14 adjusted by an additional 33.6 kg per Table 5.153.
[171] *Id.* at 4-71, 5-428. Ford F150 assigned to level MR3 per Table 4.49. Level MR3 is equivalent to 10% mass reduction per Table 5.179..
[172] *Id.* at 5-394.

the projected additional mass reductions projected for some vehicles may move beyond limits established by EPA (e.g. the 3,197 lb. minimum weight for OMEGA vehicle types 1-7 and 13)[173] or into material solutions that are not yet practical for mass production. EPA should consider a process to identify mass reduction technologies already applied relative to the 0% point of the mass reduction curves for the MY2008 fleet prior to the next step of the MTE process.

Adjustment of 2008 / 2014 Curb Weights for 4WD / AWD vs. 2WD

In the Draft TAR, EPA describes the process used to adjust MY2008 and MY2014 curb weights for the presence of four-wheel drive or all-wheel drive (4WD / AWD) systems relative to two-wheel drive (2WD) variants.[174] Exactly how these adjustments were applied and their impact on the analysis is unclear due to the lack of a document showing the specific calculations as actually applied to the fleets. In general, the description of why this adjustment is made was confusing and failed to provide insight to readers that are not privy to the calculations made. The Alliance reserves judgment on the specific application of the analysis pending further review.

Although it is unclear exactly how these adjustments were applied to the baseline vehicles, the data used to derive the adjustment factor itself was clear. EPA describes an evaluation of three different vehicles with both 2WD and 4WD / AWD systems and the curb weight difference for each. The average of these three vehicles is taken and then rounded down to the nearest 100 lb. The Alliance notes that three vehicles are hardly a representative sample when EPA itself has extensive databases of certification data (e.g. Verify) that include data on drive configuration and curb weight. Use of such databases (after filtering to ensure similar levels of other features) could prove to be a more robust source of data. Presuming that the three vehicles measured in the referenced study do actually represent typical 4WD/AWD systems, it would have been more appropriate to weight the average by the number of sales of the different system types. For example, if the majority of 4WD/AWD systems are more similar to the Ford Fusion (an AWD system designed for improved traction in a passenger car), the average would move towards lighter weights Conversely, if the majority are more similar to the Jeep Cherokee (a full 4WD system designed for extreme off-road use), the average would move towards heavier weights. Although the time provided for comment on the Draft TAR is insufficient for the Alliance to provide a full numerical analysis to the EPA, we urge the Agency to develop a more robust analysis prior to the next step of the MTE.

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173 *Id.* at 5-401.
174 *Id.* at 5-395.

Adjustment of 2014MY Fleet Curb Weights for Footprint and Safety

The Alliance agrees that it is appropriate for the EPA to adjust the curb weight improvements for footprint increases and added safety features between MY2008 and MY2014.[175] This approach recognizes that mass reduction technology has been applied, but that other added features have resulted in a net mass savings lower than the theoretical mass reduction relative to the cost curves. We also concur with the Agency's intent to consider future safety related mass additions when determining the cost of net mass reductions and the capability for individual vehicles to reduce mass by a given percentage.[176]

The EPA provides estimates for mass added associated with safety improvements in the MY2008-2014 time period and for future safety improvements.[177] The Alliance reserves judgment on the appropriateness of the values presented and may choose to comment further in the future.

Lack of Consideration of Mass Reduction Technologies Applied Without Concurrent Curb Weight Reductions

EPA does not provide an adjustment to the resultant mass reduction cost curves in cases where mass reduction technology is applied, but the net mass reduction is less than the gross mass reduction expected from the technology application, except in the cases of added safety features and footprint increases.[178]

The Alliance recommends that the EPA undertake a more robust analysis of the types and levels of mass reduction technology applied in the baseline to replace the simplistic curb weight difference-based analysis prior to the next step of the MTE.

Comments on the NHTSA Approach to Baseline Mass Reduction

The NHTSA approach to establishing baseline mass reduction for the purposes of determining the costs of future mass reductions can broadly be summarized as a statistical evaluation of the MY2015 baseline fleet where vehicles are assigned an existing level of mass reduction based on analysis of the residuals from a regression analysis.[179] Vehicles with positive residuals (effectively higher mass than the predicted mass based on various vehicle features) were assigned a mass reduction of 0% (Level 0). Those with negative residuals (lower than predicted

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[175] *Id.* at 5-395 et seq.
[176] *Id.* at 5-402.
[177] *Id.* at 5-402.
[178] Although not directly stated in the Draft TAR, this is clearly evidenced by the simple calculation of the difference in MY2014 curb weight to the MY2008 curb weight.
[179] *Id.* at 4-65 et seq.

mass based on vehicle features) were assigned progressive levels of mass reduction already obtained, with the maximum level of mass reduction set at 15% (MR5).

Prediction of Curb Weight for Use in Determining Level of Mass Reduction Present

In NHTSA's approach, the regression model considered body design categories (3-Box, 2-Box, and Pickup), footprint, horsepower, electrification, battery pack size, drive configuration and whether the vehicle was a convertible. Adjusted R-squared values ranged from a low (poor correlation) of 0.461 for pickup trucks up to 0.883 for 2-box vehicle designs.[180] That higher correlation could not be achieved is a concern, especially for pickup trucks. It is indicative that the parameters chosen are likely insufficient to adequately predict curb weight. In the recent ControlTec Load Reduction Study, a similar analysis was performed and the key determinants of curb weight identified as vehicle cubic volume and vehicle type (accounting for 87% of variation in curb weight).[181]

Additional parameters were also identified which improved the correlation to 95%. The Alliance recommends that NHTSA review the ControlTec Load Reduction Study for consideration of additional parameters to improve the NHTSA model correlation to the baseline vehicle fleet.

The Alliance is also concerned with the approach taken of applying a regression model to determine the level of mass reduction technology applied. Although we agree that a regression model may be useful for comparing actual levels of mass reduction achieved between vehicles and even for estimating potential future mass reductions without consideration of costs (as in the approach taken in the ControlTec Load Reduction Study),[182] applying such a model to determining levels of mass reduction technology already applied can be problematic. (The distinction between technology level and mass reduction level achieved is important because it is the level of design optimization and lightweight technology application already implemented which determines the cost for additional future mass reduction, not the level of mass reduction achieved relative to the baseline of the cost curve or in comparison to other vehicles.) There are three key issues that arise with this approach: (1) the average curb weight (and therefore the zero mass reduction point) changes based on the model year chosen for analysis; (2) the method does not account for mass added associated with safety and other customer expected and desired features; and (3) a regression analysis cannot determine the actual level of materials selected relative to the position of those materials on the predicted direct cost curves.

In each subsequent model year, it is reasonable to assume that additional mass reduction will occur, thereby theoretically lowering the average curb weight predicted by a regression model. Over time, the zero residual values will become progressively lower. This will force the

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[180] *Id.* at 4-65 to 4-67.
[181] ControlTec Load Reduction Study, p. 49 et seq.
[182] *Id.* at 45 et seq.

estimated degree of mass reduction technology applied into progressively lower categories as can be observed with the Ford F150 example above. Theoretically, this problem can be avoided to some extent by developing the regression analysis on the baseline year associated with the cost curve. However, the other two additional issues identified cannot be addressed so easily and still have a significant impact on the accuracy of applying a regression model-based analysis to determine the level of mass reduction technology applied.

The Alliance recommends that alternative approaches be considered that could more accurately capture the level of mass reduction technology already applied relative to the developed cost curves.

Determination of Baseline Aerodynamic Drag Improvement Level

As described in Appendix B of these comments, EPA and NHTSA have pursued different paths for defining the initial aerodynamic state of the vehicles in their baseline fleets. Both of these methods give no consideration to vehicles that have already adopted aerodynamic improvements. This means that all vehicles are candidates for up to a 20% reduction in aerodynamic drag. An assumption that all vehicles are capable of 20% aerodynamic improvement, regardless of where the vehicle starts, will lead to an overly optimistic assessment of possible aerodynamic load reduction.

Determination of Baseline Tire Rolling Resistance

Section 5.2.6.1 of the Draft TAR reports on the state of tire technology.[183] That section notes that "low rolling resistance tires are increasingly specified by OEMs" yet neither Agency recognized that fact when defining their initial, baseline fleets. As a result, the Volpe and OMEGA models continue to apply low rolling resistance tire technology on top of what has already been specified by manufacturers.

NHTSA's MY2015 baseline fleet analysis contains no recognition of low rolling resistance tires (based on the market data file for the Volpe model show no "USED" classifications for ROLL10 or ROLL20).

EPA gives some credit to a limited number of vehicles but the application appears inconsistent. For example, the market data file contains two columns titled "Estimated Tire RRC" (column DS) and "Low Rolling Resistance Tires" (column EF). When filtering for vehicles that do NOT have low rolling resistance tires, the range of estimated tire RRC is 4.4 to 15.1. When filtering

183 Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 5-152.

for vehicles that DO have low rolling resistance tires, the range is 4.9 to 10.1. This wide overlap is confusing, should be explained, and may need to be revisited by EPA.

Clearly, some definition of low rolling resistance is required to specify which vehicles have already applied some level of this technology. The Alliance generally proposes the values used by Argonne National Labs in Table 5.219 in the Draft TAR.[184] We note that some additional consideration may need to be given to certain types of vehicles (e.g. high performance vehicles and those designed for off-road use) similar to what was done in the ControlTec Load Reduction Study. With these types of values, ROLL10/LRRT1 and ROLL20/LRRT2 can be defined. Table 3-1 below shows the reference Argonne values as well as the 10% and 20% target values.

Table C-1: Argonne National Labs Reference Rolling Resistance

	Small Cars	Midsize Cars	Small SUVs	Midsize SUVs	Pickups
Reference RRC	0.0075	0.008	0.0084	0.0084	0.009
ROLL10/LRRT1 RRC	0.00675	0.0072	0.00756	0.00756	0.0081
ROLL20/LRRT2 RRC	0.006	0.0064	0.00672	0.00672	0.0072

With these objective numbers, the baseline fleet of vehicles can be categorized according to their actual performance. The Alliance and its members could assist the Agencies with this update.

The Alliance also recommends the following refinements:

1. As with aerodynamics, the designation of rolling resistance reduction should be the center of the range instead of the start of the range. For example, a ROLL10/LRRT1 vehicle should be any vehicle that is 5% to 15% better than the reference value. This is consistent with NHTSA's method for mass reduction where a vehicle is considered to have 5% mass reduction (MR1) for the range of 3.75% to 5.625% below trend.

2. The Agencies should also consider reducing the step size from 10% to 5%. This will provide greater resolution in the results. Combined with the previous recommendation, the ROLL10/LRRT1 vehicle would range from 7.5% to 12.5% of the reference rolling resistance.

Other Technologies in the Baseline Fleet

As demonstrated for vehicle load reduction technologies (mass, aerodynamic, and tire rolling resistance), the assessment of the presence of certain technologies can be a challenge,

[184] *Id.* at 5-503.

particularly when the technology is not a single component, but an implementation of various features, or masked by other competing factors. This is also the case for other technologies such as engine friction reductions, improved accessories, and certain transmission and driveline-related improvements. To the extent permitted within the Draft TAR comment period, and potentially following the close of the comment period, the Alliance expects that individual manufacturers will attempt to identify areas in which the Agencies have underestimated the level of technology deployment in their respective vehicles.

Other Concerns Regarding the Agencies' Baseline Discussion

In general, the Draft TAR Chapter 4[185] discussion of the baseline, reference, and control fleets is confusing and appears to be overcomplicated, and yet is still only based on a single year's worth of sales data from MY2014 projected out to MY2025. Also, it is unfortunate that the pull-ahead in timing of the Draft TAR resulted in using data even further in advance of MY2022-2025. The Agencies note that this can present a skewed picture as models enter and exit the market, which they believe works out over time. However, why is it not more appropriate to build a baseline fleet off a multi-year average as opposed to a single point in time? For example, EPA uses MY2014 as the baseline year, but applies MY2015 AEO2015 car/truck split assumptions. It is not clear if this is appropriate and if this is part of the reason that both the car/truck split and total vehicles sold values do not line up between the "Reference Case" and "Unforced Reference Case."[186] It is also difficult to compare baseline fleets between the Agencies when there is no alignment between the Agencies on the starting year. One of the more significant concerns is that the EPA did not present any interim projections when looking to MY2022, therefore the new forecasted picture between now and then is not clear.

The Agencies note that the reference fleet assumes all characteristics of individual vehicle models, except CO_2 emissions remain unchanged through MY2025. Therefore, the Agencies are assuming that any fuel efficiency technology added will not improve vehicle performance or utility.[187] However, this approach does not consider the case where technology added for fuel efficiency can degrade performance or utility, or that customers largely demand increasing performance and utility. The Alliance agrees that the potential tradeoffs between reducing CO_2 and improving other vehicle attributes deserves consideration, but the method should include more than reviews of limited modeling studies, and involve future work with automakers and customer research groups to focus instead on understanding the "hidden costs" associated with these technologies.

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[185] *Id.* at 4-1 et seq.
[186] *Id.* at 4-10, Tables 4.4 and 4.5.
[187] *Id.* at 4-26.

In the development of the reference fleet, EPA notes that, identical to their 2012 FRM analysis, they assumed the reference fleet will meet the MY2021 standards because gas prices were predicted to be stable through 2025, and the consequences of this were that only companies that build "lighter vehicles" would over-comply.[188] However, this fundamental assumption that gas prices would be stable was not correct. We suggest that the Agencies determine how this assumption affected the development of the reference fleet in MY2012 and what impact it could have on the current reference fleet assumptions. Further, we suggest that the Agencies considered the impacts of other regulations that affect CO_2 in the development of the reference and baseline fleets.

The Agencies discuss the idea that industry will not act absent regulations that will drive "major innovation,"[189] but do not appear to recognize that the industry innovates in many areas–not just in fuel economy–and that not all automakers innovate with the same focus. It is this diversity that has resulted in today's highly advanced vehicles that continually provide improved safety, features, and utility. It has also resulted in major innovations in areas like autonomous driving, which can also impact fuel efficiency of the fleet. Further, the Agencies should recognize that relying on best-in-class technology improvements for the entire fleet could be problematic where patents may protect certain unique innovations.

[188] *Id.* at 4-26.
[189] *Id.* at 6-8.

Appendix D: Cost Optimization Modeling (OMEGA / Volpe Model)

As was previously discussed in these comments, the Alliance believes that the Agencies have underestimated the technologies and costs required for compliance.

The limited time available to assess the Draft TAR has prevented the Alliance from preparing in-depth comments on the specific methods and constraints applied by the Agencies in their OMEGA and Volpe Models. However, we offer these preliminary comments and may choose to submit supplemental comments regarding these models at a later date.

Upstream GHG Accounting

In its OMEGA modeling, EPA has assumed zero upstream (i.e. electric utility provider) emissions for battery electric vehicles and the electric portion of operation for plug-in hybrid electric vehicles. Although the Alliance agrees that zero upstream emissions is appropriate,[190] under the current regulation manufacturers that exceed certain production thresholds of advanced technology vehicles are required to add upstream emissions. This accounting degrades the compliance benefits of plug-in electric vehicles by raising the calculated tailpipe CO_2 value. The Alliance recommends that EPA analyze the sales of advanced technology vehicles modeled for each manufacturer and determine if any manufacturer is projected to exceed the production thresholds for the 0 g/mi advanced technology vehicle incentive. If a manufacturer is modeled as exceeding the applicable thresholds, then EPA should include the negative impact of upstream GHG accounting in its analysis unless and until upstream emission accounting is removed from the rule.

Response to EPA Sensitivity Analysis

In Section 12.1.2 of the Draft TAR,[191] EPA provides a number of sensitivity analyses. In its observations based on these sensitivity analyses, EPA notes that fuel prices have little impact on the cost per vehicle outcomes, little impact on the technology penetration outcomes, and do not result in substantially different fleet electrification.[192]

The EPA's sensitivity analysis in regards to fuel prices is fundamentally flawed. EPA notes that the primary difference in the OMEGA modeling caused by the change in fuel price is a shift between car and truck fleets. What the Agency fails to consider is that in developing the reference and control case fleets, once the car and truck fleet splits are established, only minimal

[190] *See* Alliance comments at Appendix G for additional detail.
[191] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 12-36 et seq.
[192] *Id.* at 12-40.

differences would be expected from the OMEGA model. This is because it does not consider customer choice and iteratively modify the subsequent vehicle and powertrain selection characteristics. The EPA's analysis does not account for the market moving away from (or toward) higher efficiency powertrains to (or from) lower efficiency powertrains in the same vehicles. Nor does the EPA analysis account for market shifts within the passenger car segments (which are more closely aligned with the footprint-based target curve) to (or from) compact and mid-size utility vehicles (which are generally more challenged to meet the passenger car target curve). If these market shifts were also considered (and not just a general car fleet versus truck fleet shift), the sensitivity to fuel price would likely be much higher. The Alliance recommends that the Agencies develop or purchase a full customer choice model which takes issues such as those described above into account.

Appendix E: Economic Considerations: Customer Acceptance

Introduction

It is clear that both NHTSA and EPA are obligated to take economic considerations into account as part of the MTE, as both Agencies have statutory obligations in this regard. In NHTSA's case, the Energy Policy and Conservation Act [193] specifies that, in determining the "maximum feasible average fuel economy" for a given model year, NHTSA must consider four factors, one of which is "economic practicability." [194] There is a long history of NHTSA rulemakings on fuel economy standards in which NHTSA has discussed the meaning of the "economic practicability" criterion and applied its interpretation of that criterion in making decisions about fuel economy standards. Section 202(a)(2) of the Clean Air Act also requires EPA to take economic factors into account in setting standards applicable to the emission of air pollutants, stating that EPA must give "appropriate consideration to the cost of compliance" with its standards in light of the amount of lead time allotted for compliance. [195]

In addition to these statutory requirements, it is also clear that the MTE regulations themselves require a robust consideration of economic issues prior to the issuance of a final determination. The light-duty vehicle greenhouse gas regulations set forth a list of factors that EPA must consider as part of the MTE process, including at least two factors that are unmistakably "economic" in nature: "[t]he cost on the producers or purchasers of new motor vehicles or new motor vehicle engines," and "[t]he impact of the standards on the automobile industry." [196] Moreover, the preamble to the final rule setting the MY2017 and beyond GHG and CAFE standards made it clear that EPA will consider a range of economic factors as part of its decision-making process:

> The decision making required of the Administrator in making that determination is intended to be as robust and comprehensive as that in the original setting of the MY2017-2025 standards. In making this determination, EPA will consider information on a range of relevant economic factors, including but not limited to those listed in the rule and below:
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> ***
>
> 2. Impacts on employment, including the auto sector.
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> ***

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[193] 49 U.S.C.A. § 32902(f).
[194] *Id.*
[195] 42 U.S.C.A. § 7521(a).
[196] 40 CFR § 86.1818-12(h).

5. Costs, availability, and customer acceptance of technologies to ensure compliance with the standards, such as vehicle batteries and power electronics, mass reduction, and anticipated trends in these costs.

6. Payback periods for any incremental vehicle costs associated with meeting the standards.

7. Costs for gasoline, diesel fuel, and alternative fuels.

8. Total light-duty vehicle sales and projected fleet mix.

9. Market penetration across the fleet of fuel efficient technologies. [197]

All of the factors listed immediately above relate to the economic impacts of the proposed GHG standards(with the exception of item 2 above--employment impacts, which will be the subject of Appendix F) and these items implicate customer acceptance of vehicles meeting the MY2022-2025 standards.[198]

Customer acceptance is, therefore, a complicated subject. At the most basic level it depends on the vehicle attributes that customers value. Customers value fuel economy, but they also have other requirements. Is the vehicle large enough to fit their family? Does it offer the right features, handle well in inclement weather or poor road conditions, and provide sufficient towing and payload capability? Most importantly, can the customers afford it? The numerous errors made in defining the baseline fleet, coupled with the selection of optimistic data for assessing the effectiveness and costs of future technologies, give reason to conclude that the MY2022-2025 standards will require dramatic marketplace changes that custom er are not currently prepared to accept.

The 2012 FRM emphasized that an analysis of customer acceptance was vital to the assessment of whether the MY2022-2025 GHG and CAFE standards were appropriate.[199] Last year, however, the Agencies made a decision to accelerate the timing of the Draft TAR. This means sufficient data as to the effectiveness of the MY2017-2021 program – including data on customer response- is not yet available, because the program has not yet taken effect. Instead, the

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[197] 77 Fed. Reg. 62784 (Oct. 15, 2012).

[198] The Alliance recognizes that the Draft TAR is a technical assessment rather than a decision document, and that the agencies' final MTE determinations will be based on a body of information that is larger than the Draft TAR. Thus, the Draft TAR may not contain all of the material that the agencies will use to draw conclusions on the economic impacts of the CAFE and GHG standards, as required by the various statutory and regulatory provisions outlined above. Having said that, we understand that the Draft TAR contains the bulk of the data and analyses that the agencies plan to rely upon for their final decisions. If so, it is clear that the information set forth in the Draft TAR is insufficient to support the economic determinations that the agencies will be required to make.

[199] 77 Fed. Reg. 62784 (Oct. 15, 2012). See generally the description of the mid-term evaluation and inclusion of customer acceptance as a relevant factor.

Agencies are focused on the impact of the MY2012-2016 standards which neither require the same stringency nor are representative of the cumulative effects of the regulation as a whole. It is not reasonable to expect that customers will react the same in MY2022 - 2025 as they have through MY2016 in response to the changes to the fleet required by the Agencies.

The importance of conducting meaningful research to help better understand customer acceptance has been echoed by many organizations. Recently, a committee of experts completed a 30-month study under the direction of the National Research Council (NRC).[200] After hearing expert testimony, reviewing the literature, and engaging expert panelists, the NRC issued a final report that included the following recommendations:

> **Recommendation 9.1** The Agencies should do more research on the existence and extent of the energy paradox in fuel economy, the reasons for consumers' undervaluation of fuel economy relative to its discounted expected present value, and differences in consumers' perceptions across the population.
>
> **Recommendation 9.2** The Agencies should conduct more research on the existence and extent of supply-side barriers to long-term investments in fuel economy technologies.
>
> **Recommendation 9.3** The Agencies should study the value of vehicle attributes to consumers, consumer willingness to trade off other attributes for fuel economy, and the likelihood of consumer adoption of new, unfamiliar technologies in the vehicle market. This will enable the Agencies to better understand consumer response to the CAFE rules and better assess the rules' costs and benefits.[201]

Notwithstanding the central importance of this issue, less than 30 pages of the 1,200 page Draft TAR are dedicated to evaluation of customer acceptance. After providing a cursory literature review, the Agencies conclude that they cannot make any significant conclusions.

We urge the Agencies to revisit this critical topic to ensure that the regulations they deem "technically feasible" do not result in market failures and subsequent economic impacts. The customer acceptance challenges of meeting the MY2022-2025 standards are real and need to be dealt with in the MTE. To perform an appropriate cost-benefit analysis, the Agencies must address a wide variety of customer acceptance concerns. If the standards are out of line with the market they will not be met.

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[200] "Cost, Effectiveness and Deployment of Fuel Economy Technologies for Light-Duty Vehicles." National Academy of Sciences, National Research Council to the National Academies. 2015.
[201] *Id.* at 333-334.

Without the tools to understand customer response, the Agencies will not be able to understand the current situation with its lower fuel prices, much less the more complex aspects of customer acceptance. Such factors include the effect on customers who could either be priced out of the new car market or who fail to find vehicles with attractive attributes and features; the possible loss of environmental benefits as older vehicles remain in the field longer and are not replaced by newer, cleaner and more efficient models; and the potential financial effects on automakers and their employees who could face significant penalties and investment loss if higher cost, low-emitting vehicles are rejected by customers.

Even in the Current Environment, Low Fuel Prices Have Retarded Acceptance of High Technology Vehicles

Even in the current market of record-breaking vehicle sales, the majority of customers are not adopting the most advanced technology or efficient vehicles. The Alliance believes one primary factor is low gas prices. The assumptions about gas prices that the Agencies relied upon in the 2012 FRM deserve examination. The ONP was launched with an expectation of structurally high gas prices but is unfolding in a period of sustained lower gas prices, profoundly impacting customer choice. In the Agencies' original analysis in the 2012 FRM, they predicted gas prices would be $3.87 in 2010 dollars by 2025, or about $5 a gallon. This assumption was made when fuel prices were at their highest level in the past 40 years, exceeding those of the late 1970's and early 1980s.[202]

When gas prices fall, especially in the context of improving mileage across segments of the market, the desire to walk out of the showroom with a hybrid (or other alternative powertrain) diminishes (Figure E-1).

[202] "Short-Term Energy Outlook." U.S. Energy Information Administration. Accessed September 21, 2016. http://www.eia.gov/forecasts/steo/realprices/.

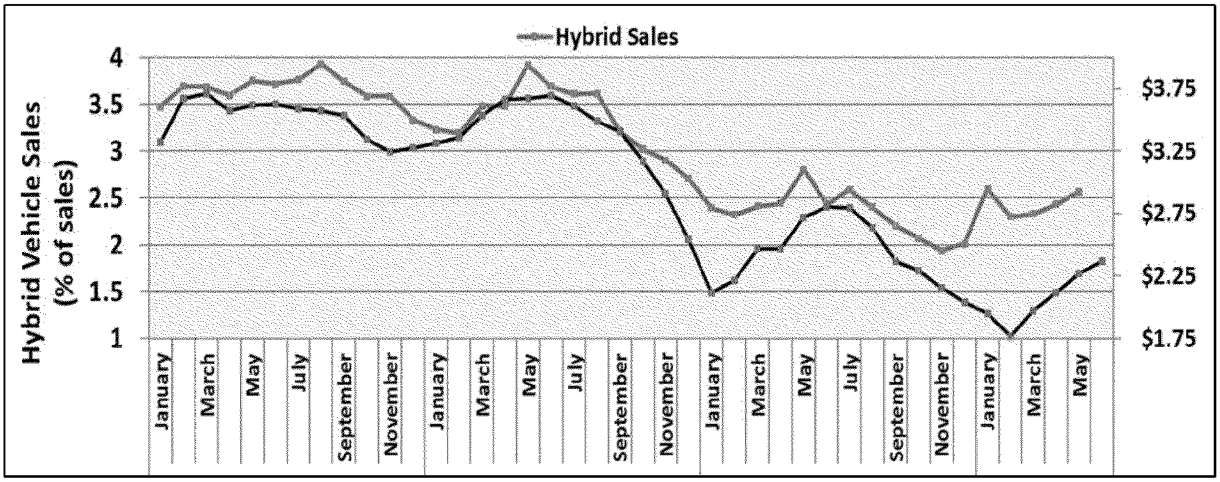

Figure E-1: Retail Market Share of Hybrids and Gas Prices, 2013-2015

Some would point to the attribute-based (i.e. footprint) CAFE requirements for cars and trucks as a complete solution to counteract any shifts in customer choice due to low gas prices. Although attribute-based standards help ensure the entire fleet improves regardless of large shifts in demand, customers still choose how much they are willing to spend on features other than fuel efficiency improvements *within the same vehicle platform* (even within the same footprint and class). Often *within a model*, customers demand options for different levels of performance and features that affect FE and GHG emissions. For example, customers are overwhelmingly choosing to purchase a model with a conventional powertrain in lieu of that same model with a hybrid electric powertrain – over 92% of customers purchase the conventional powertrain when a choice is available.[203] Additionally, customers are moving from sedans to car-based sport utility vehicles that have similar footprints but greater utility and lower fuel economy. As a result, achieving FE targets even within a particular vehicle footprint/platform depends on customers' willingness to pay for the greater FE options within that platform. We believe that the EPA and NHTSA incorrectly assume via the Draft TAR that customers will make such vehicle efficiency decisions irrespective of the costs involved.

What Will It Take to Achieve the Future Requirements?

The Agencies are correct in finding that automakers are meeting the current GHG and CAFE standards. In the early years of the program, automakers succeeded in significantly increasing FE by rapidly deploying a variety of near-term technologies that can improve mileage while keeping

[203] Calculated from data provided R.L. Polk & Co. Retail sales of sedans and SUVs offered as either gas-powered or hybrid, January 1, 2015 through May 31, 2016.

new vehicles affordable. In its most recent Light-Duty Vehicle Fuel Economy Trends Report,[204] EPA found that more than 98% of new vehicles now incorporate variable valve technology while more than 85% of new vehicles have an advanced transmission (dual clutch transmission, continuously variable transmission, or 6+ speeds).[205] It is important, however, to note that some manufacturers could be using over-compliance as a strategy to bank credits for future, more stringent standards. Automakers have also moved with startling speed to add alternative powertrain options. In MY2015, this included 46 models of hybrids, 18 electric models and 12 plug-in hybrids, plus literally hundreds of new high-MPG gas and diesel offerings.[206] The industry's innovations have also resulted in a fast-growing selection of energy-efficient models. According to www.fueleconomy.gov, the number of models achieving EPA label ratings of 30 MPG or higher highway fuel economy has grown by over 700% since 2006, while the number of models achieving 40 MPG or more has increased tenfold over the same period (Figure E-2).

	30+ MPG	40+ MPG
2006	69	7
2007	76	2
2008	113	5
2009	149	8
2010	204	13
2011	235	20
2012	299	34
2013	405	50
2014	450	66
2015	495	76
2016	509	80

Figure E-2 Number of Vehicle Models Exceeding 30 and 40 MPG Based on EPA Highway Fuel Economy Rating[207]

[204] "Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2015." Environmental Protection Agency. EPA-420-R-15-016. 2015. Accessed September 17, 2016. https://www3.epa.gov/fueleconomy/fetrends/1975-2015/420r15016.pdf.
[205] *Id.*
[206] Accessed September 26, 2016. www.FuelEconomy.gov
[207] *Id.*

The MY2022-25 Standards Represent an Unprecedented Challenge

Going forward, we know that manufacturers will continue to implement technologies to further FE and reduce GHG emissions. What is uncertain, however, is whether it is realistic to expect that customers will purchase the vehicles that achieve fuel efficiency gains that are sufficient to satisfy the GHG standards and CAFE standards for MY2022-2025 or to cover any gaps originating through MY2021 as a result of lower gas prices or economic conditions. The target schedule assumes efficiency gains of about 5% per year for cars and about 3.5% per year for trucks during the MY2012-2021 portion of the program.[208] The four subsequent years impose an expectation of efficiency gains of about 5% per year for both cars and trucks. As the chart below illustrates, the road ahead is steeper. Note, that although the CO_2 grams per mile reductions would be more linear, the fuel economy curve better highlights the increasing difficulty, or asymptotic difficulty, in approaching zero CO_2 g/mi emissions and higher fuel economy. (Figure E-3).

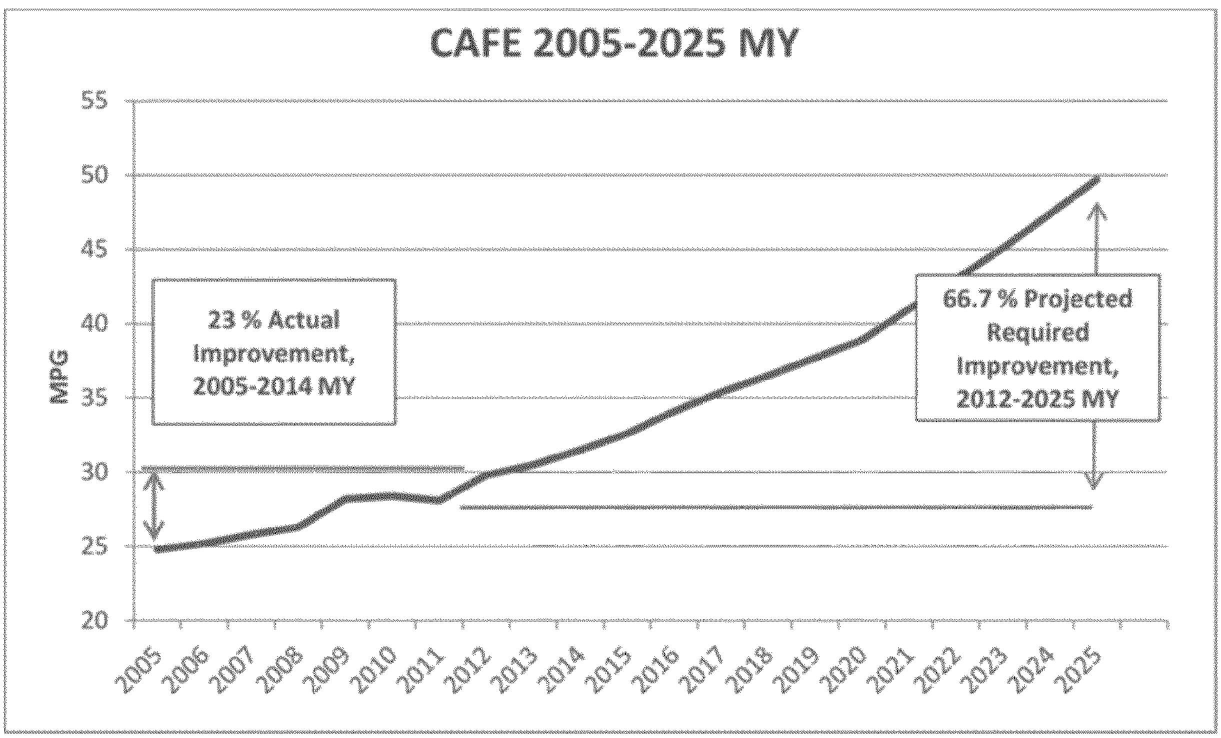

Figure E-3 Historical and Projected Industry Fleet Average CAFE Standards (MY2005-2025)

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[208] Significantly, the compliance path for "cars" becomes more difficult in the out years as the trend away from sedans to car-based CUVs continues. CUVs have customer desired attributes but a more difficult compliance path than sedans.

One way to further illustrate this challenge is to consider what would need to occur with each major model redesign. The estimated average production life for a freshly redesigned vehicle ranges from 4.5 to 9.7 years, with most vehicles in the 5- to 7-year range.[209] (Trucks tend to have the longer redesign ranges.) This means that a car redesigned in MY2025 would need to achieve a 25-35% improvement in fuel economy; a truck redesign in MY2025 would need to achieve a fuel economy increase of 22.5-29%.

Citing the recent Light-Duty Vehicle Fuel Economy Trends Report, the Agencies point to automakers' current compliance with the CAFE and GHG standards as proof of the efficacy of the future GHG and CAFE standards.[210] In this case, however, past compliance is a poor barometer for measuring future ability to comply. The key question is not *whether* the manufacturers have complied thus far, but *how* this has been achieved.

One way that manufacturers have kept ahead of the requirements is by quickly introducing new fuel-saving technologies. In its Light-Duty Vehicle Fuel Economy Trends Report,[211] EPA reported that variable valve timing and multi-valve engines would be used in all MY2015 vehicles and noted that gasoline direct injection and turbocharged engines had increased five-fold since MY2010. EPA also noted significant increases in transmissions of six or more speeds and continuously variable transmissions (CVT).[212]

By quickly introducing these changes, however, the manufacturers are drawing from a limited pool of proven near-term technologies that they will soon exhaust. The Agencies express confidence in the continuing rapid pace of technology deployment, but seem to disregard the delta between available and relatively inexpensive technology and longer-term pathways that are recognized to cost more and come with greater customer acceptance hurdles.

Another way manufacturers have kept up with increasingly stringent CAFE and GHG standards is by making use of certain credit-generating mechanisms. These mechanisms, which were part of the agreement reached between the Agencies and the manufacturers, have provided appropriate credit for past investments and awarded manufacturers for accelerating the deployment of advanced CO_2 reducing technologies earlier than expected. Credits for CO_2-reducing technologies were supported by all stakeholders as an appropriate part of the ONP. The significant and early use of credits by manufacturers that have elected to invest in these technologies reflects individual choices driven by unique business plans and ongoing

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[209] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 4-57, Table 4.42.
[210] *Id.* at 3-2.
[211] "Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2015." Environmental Protection Agency. EPA-420-R-15-016. 2015.
[212] *Id.*

assessments of technology pathways. This is equally true for manufacturers that have elected to engage in credit trading with other producers. Trading was supported by the Agencies as a means to achieve cost-effective compliance. Manufacturers again will continue to assess trading relative to investment in technology.

While credits are a welcome and appropriate part of the ONP, the significant use of credits by some manufacturers is also a sign of their struggles to meet the pre-MY2022 standards, indicating potential longer-term issues. This is especially true for manufacturers that have relied on credits purchased from other companies, since there is no guaranteeing that today's credit suppliers will continue to generate or sell surplus credits. Even assuming there are manufacturers in the market with credits they are willing to sell, credit costs are bound to increase as manufacturers complete the deployment of near-term technologies and begin needing to deploy costlier changes.

The MY2022-2025 Standards Require Dramatic Marketplace Changes

In the Draft TAR, the Agencies point to past over-compliance and a growing range of fuel-efficient technologies, expressing a preliminary view that automobile manufacturers can meet or exceed both the GHG standards currently in place and the CAFE standards. One way to assess the Agencies' expectations is to examine the percentage of MY2015 vehicles that meet future CO_2 emission targets. The Agencies have said that the MY2025 compliance does not require significant hybridization or electrification, but that seems to reflect a leap of faith that transcends current technology realities. The results as shown in Figure E-4 are intriguing: EPA reports that 22% of MY2015 vehicles operating on diesel or gasoline meet the MY2018 CO_2 emissions targets or can do so with the addition of expected air conditioning improvements. Future MPG targets are so high that fewer than 4% of current models meet MY2022 targets, and the sales of these most energy-efficient vehicles remain low. Currently, *no* diesel or gas (non-hybrid) vehicles make the MY2025 target.

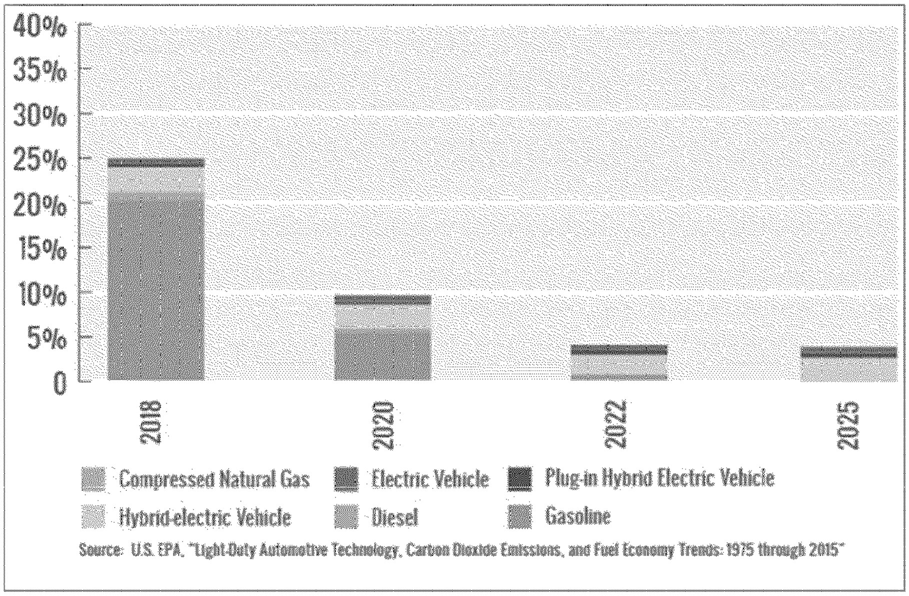

Figure E-4 MY2015 Vehicle Production that Meets Future Greenhouse Gas Targets

A recent analysis by Novation Analytics, further illustrates th is concern (attached as Attachment 5).[213] Novation Analytics found that manufacturers will need to appl y more technologies than were predicted by the 2012 FRM as needed to meet projected targ ets, and that the post-MY2021 standards cannot be achieved without significantly higher sales of advanced technology vehicles, including HEVs, PHEVs, and BEVs.

Thc Novation Analytics analysis , which rclics on EPA and NHTSA data, has bccn sharcd with the Agencies. It finds that certain milestones need to occur i n order for manufacturers to meet the MY2022-2025 standards:[214]

- by 2021, the fuel economy performance of the entire fleet will need to equal today's most efficient gasoline vehicles;
- by 2021, vehicle loads will need to be reduced by 1% annually (by reducing mass, improving aerodynamics and adopting low rolling resistance tires); and
- by 2025 the entire fleet will need to achieve the 10% load redu ction and exceed the fuel efficiency of today's most efficient gasoline powertrains.

Novation Analytics concludes, "[m]oving the entire industry to the current best spark-ignition (SI) powertrains would provide compliance only to MY2020. Advanced SI technologies,

[213] "Trade Association Studies; Powertrain Technology Effectiveness, Phase II." Novation Analytics. Technical Briefing. May 17, 2016. Accessed September 21, 2016.
[214] *Id.*

unproven in production, and/or high rates of electrification will be required by MY2025."[215] See Figure E-5.

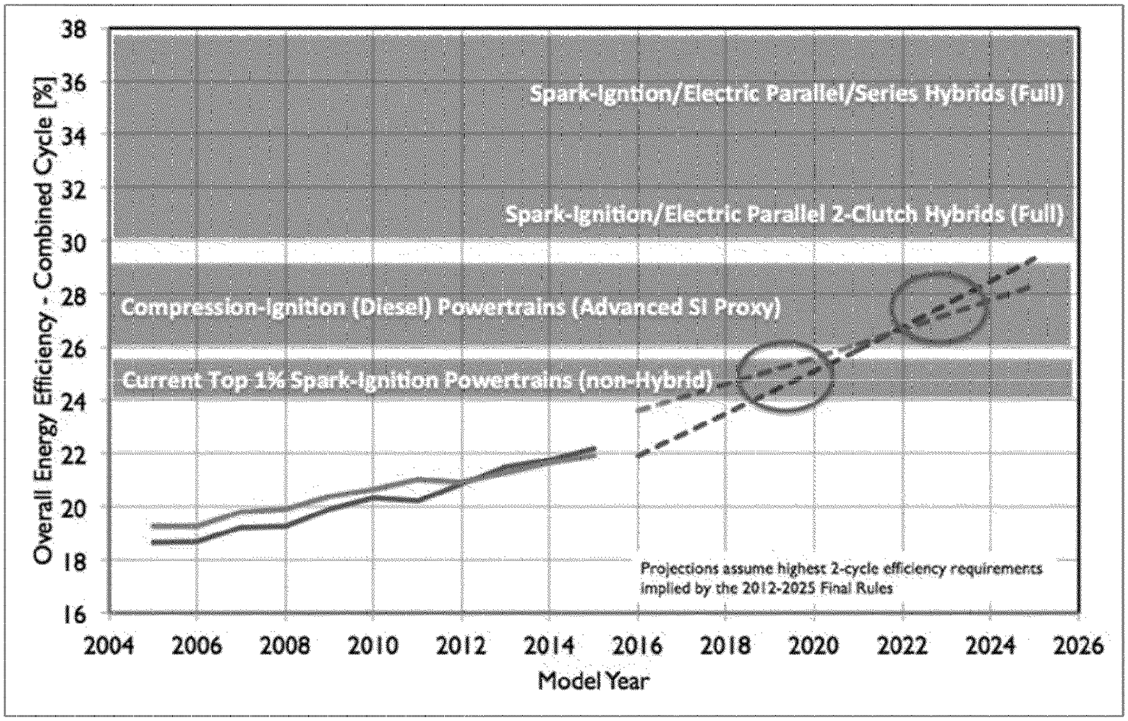

Figure E-5: Overall Powertrain Energy Conversion Efficiency Implied by the GHG and CAFE Standards and Exemplar Technologies to Achieve These Efficiencies[216]

What Customers Are Doing in the Marketplace

A key component of the MTE should be an assessment of what cust omers are doing in the marketplace.

As we move further into the target schedules, one of the great unknowns that is critical to meeting the future standards is the adoption rate of alternativ e powertrains. As Figure E-6 below illustrates, customers today overwhelmingly choose gas-powered engines over alternative powertrains.

[215] *Id.*
[216] *Id.*

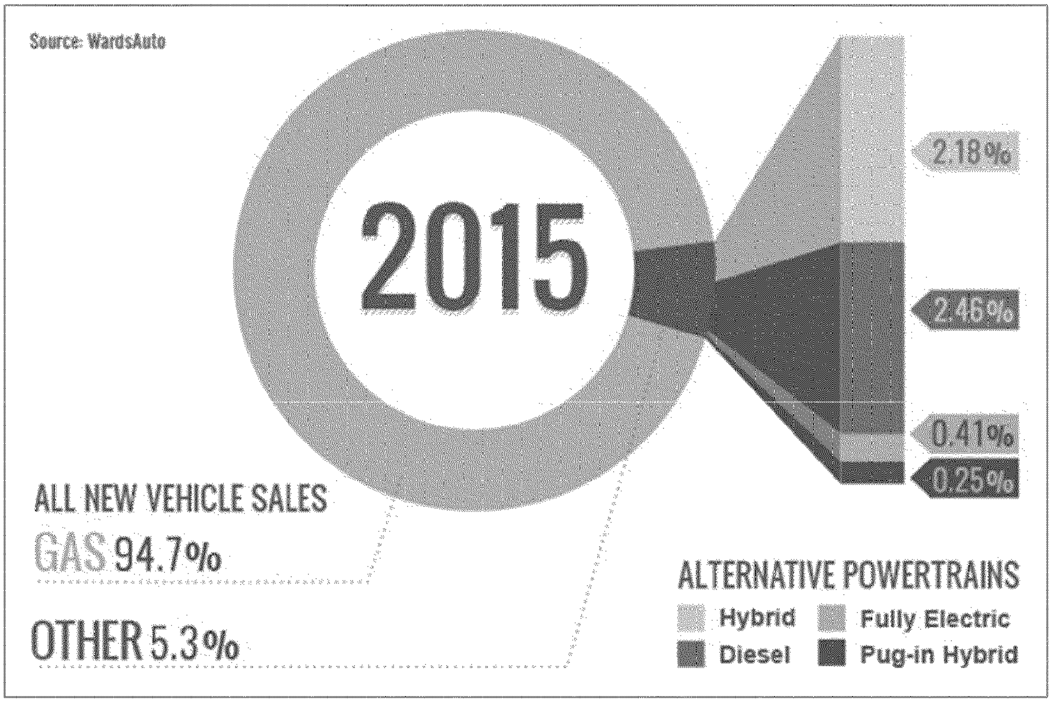

Figure E-6 MY2015 Powertrain Selection by Customers

Two possible explanations for the strong preference for ICEs are customers may be more familiar with gas-powered engines,[217] and that customers are satisfied with the fuel economy provided by gas-powered engines.[218] Further, even in the face of higher gasoline prices, the absolute benefit in cost savings and miles per gallon improveme nt of each percent of increase in fuel economy diminishes. This is called "MPG illusion", in whi ch car buyers overvalue fuel economy increases for high-mpg vehicles relative to low-mpg veh icles. Figure E-7 illustrates the issue.

[217] This despite the presence of advanced electrified technologies in the market for over a decade.
[218] As fuel economy from conventional powertrains increases, the A lliance believes that some customers have become satisfied with their current level of fuel economy and d o not wish to pay the premium to move to more advanced technologies.

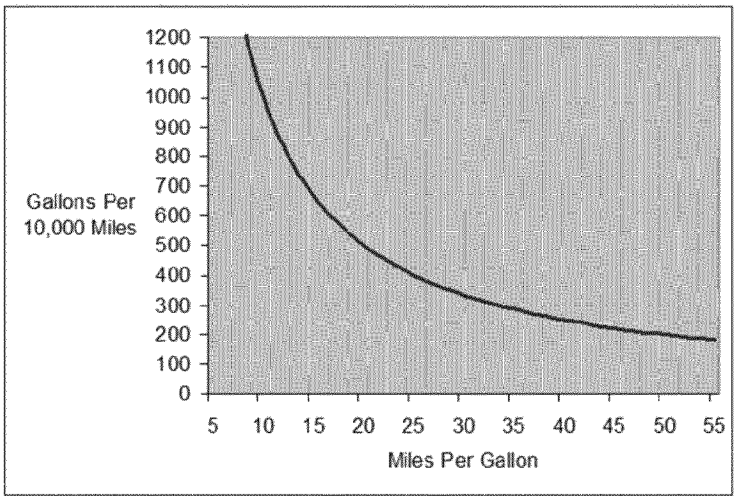

Figure E-7: As Miles per Gallon Increase, Resulting Reductions In Fuel Consumption Decrease[219]

In the Draft TAR, the Agencies state that "[i]t is difficult, i f not impossible, to separate the effects of the standards on vehicle sales and other characteristics from the impacts of macroeconomic or other forces on the auto market." [220] Nevertheless, the Agencies predict that customers will accept the technologies needed to meet the futur e standards and will be willing and able to pay added vehicle costs. The Agencies thereby sides tep critical customer research--most notably, thc post-purchasc survcy data that thc National R cscarch Council callcd "thc most reliable information about consumer preferences" [221]--and rely instead on statements made by professional auto magazine reviewers.

Rather than using the tools at h and to attempt to predict custo mer behavior, the Agencies have put customer purchasing behavior in the "too hard" bucket, side stepping this critical issue. The Agencies, thereby, would lack a basis for a conclusion that customers will accept the technologies needed to meet the future standards in a manner th at will enable the manufacturers to comply at an affordable cost.

Customer choice is complex; for over 100 years automakers have attempted to understand and predict it, but nonetheless, it is important to work to get the best possible insight on this tricky issue. The 2015 NAS report on fuel economy technologies conclu ded that the best possible insight on future customer decision-making comes from customers themselves.[222] The panel

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[219] The MPG Illusion. Accessed September 26, 2016. http://www.mpgillusion.com/.
[220] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 6-1.
[221] "Cost, Effectiveness and Deployment of Fuel Economy Technologies for Light-Duty Vehicles." National Academy of Sciences, National Research Council to the National Academies. 2015. 325.
[222] *Id.*

referred to the New Vehicle Experience Survey (NVES) conducted by Strategic Vision, a study involving more than 300,000 recent new car buyers annually, as "the most reliable information about consumer preferences." [223] The most recent NVES (see Figure E-8) shows that fuel economy, although important, is not a top purchasing reason for new car buyers.

Rank	Attribute / Purchase Reasons	Percent
1	Overall Safety of the Vehicle	64%
2	Overall Driving Performance	63%
3	Safety Features	62%
4	Front Visibility	60%
5	Braking	59%
6	Overall Value for the Money	58%
7	Price/Deal Offered	57%
8	Overall Impression of Durability/Reliability	56%
9	Riding Comfort	54%
10	Comfort of Front Seat	54%
11	Handling	53%
12	Rear Visibility	53%
13	Warranty Coverage	53%
14	Road Holding Ability	51%
15	Engine Performance	50%
16	Affordable to Buy	50%
17	Haul Cargo in Bed	50%
18	Fun To Drive	50%
19	Overall Seat Comfort	50%
20	Maneuverability	48%
21	Overall Thoughtful Engineering	48%
22	Past Experience With Brand	47%
23	Driver Seat Adjustability	47%
24	Overall Experience with Selling Dealership	47%
25	Front Seat Roominess	47%
26	**Fuel Economy/Mileage**	**46%**
Source: NVES 2016 Survey		

Figure E-8 Vehicle Buyer Purchase Reasons[224]

After reviewing NVES results, the NRC panel concluded that, "…while consumers value fuel economy, they do so in the context of other attributes they also value… they look for the most

[223] Id.
[224] Strategic Vision New Vehicle Experience Survey.

fuel-efficient version of a vehicle they already want to purchase… Consumers are buying fuel efficient versions of vehicles that suit their wants and needs."[225]

The Agencies have not attempted to identify the impacts of the MY2012-2016 standards on prices and affordability or to predict what the future standards will mean for customers. They conclude that, in the long run, customers will benefit, but never show how, or at what rate, the technologies required to meet the MY2022-2025 standards will be purchased. The Agencies are, in essence, suggesting that they are not prepared to perform a cost-benefit analysis before moving forward with a program costing billions of dollars. Ultimately, to avoid arbitrary conclusions or decision-making, the Agencies should consider analyses directly relevant to customer acceptance and the impact of customer acceptance on the industry.

Anticipated Payback Periods Far Exceed Customer Tolerance for Higher Vehicle Prices

One specific concern that must be addressed in the NPRM and the proposed determination is the wide gap between the payback periods that customers find acceptable and those anticipated by the Agencies. The Draft TAR defines payback period as "the number of years of the accumulated dollar value of fuel savings needed to recover the additional cost of technology included in the purchase price of a new vehicle." [226] EPA's analysis (not taking into account payback for costs related to the ZEV Program) concludes that the MY2025 standards will result in increased vehicle costs that customers will, on average, recover in 5 to 5 ½ years. NHTSA's analysis indicates a payback period of about 6 ½ years.

In its recent review of the CAFE standards, the NRC panel looked at the leading economic research on payback periods. The panel also met with individual manufacturers to receive their input on what customers consider an acceptable payback period. The panel found strong, consistent evidence that customers are typically willing to incur additional vehicle costs for fuel saving technologies that pay for themselves within 2-3 years.[227]

The disparity between the payback periods anticipated by the Agencies and those that customers will tolerate raises important questions regarding long-term viability of the new car market. If customers are unwilling to make up-front investments in technologies that take five or six years to pay for themselves, sales will drop. Faced with reduced profitability, manufacturers will take longer to recover their investments and have less money to invest in new technologies.

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[225] "Cost, Effectiveness and Deployment of Fuel Economy Technologies for Light-Duty Vehicles." National Academy of Sciences, National Research Council to the National Academies. 2015. 327.
[226] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 13-97.
[227] "Cost, Effectiveness and Deployment of Fuel Economy Technologies for Light-Duty Vehicles." National Academy of Sciences, National Research Council to the National Academies. 2015. 317.

Automakers Have Limited Tools to Drive Customer Acceptance

Customer response to fuel efficient vehicles and technology offerings, such as fuel efficient powertrains and optional equipment, is a critical component of the CAFE and GHG standards. Manufacturers have a limited set of tools to drive customer acceptance of a vehicle fleet that is compliant with the standards, including vehicle pricing, marketing, and limiting sales of performance powertrains or even vehicle lines.

Pricing has limited capability to drive customer acceptance, however, especially in a low fuel-price environment. As previously mentioned, customers have a wide variety of preferences and functional requirements for their vehicles, which can include performance requirements, cargo and passenger capacity, comfort, and aversion to new technologies that do not have a significant history in the marketplace. Further, discounting prices in an attempt to induce sales is not a sustainable market approach.

Marketing campaigns across the industry commonly feature fuel economy as a competitive differentiator. Automakers prominently advertise the fuel efficiency of their products and promote their fuel efficient technologies such as Ford's EcoBoost, the Chevrolet Volt, GM Ecotec, BMW EfficientDynamics, or Mercedes-Benz BlueEFFICIENCY.

In Chapter 6 of the Draft TAR, [228] the Agencies state that "development and uptake of energy efficiency technologies lags behind adoption that might be expected [as result of possible technology payback]" but this statement is inconsistent with Chapter 3 of the Draft TAR which states "[s]ince the promulgation of the 2017-2025 final rulemaking (FRM) in 2012, the automotive marketplace has undergone many changes. New vehicle sales, fuel economy, and horsepower are all at record highs. Many new technologies have been quickly gaining market share, gasoline prices have dropped by more than a third, and truck share has been increasing."[229] It is important that the Agencies recognize the significant technology push automakers have attempted as a result of this program, and that there are more highly efficient vehicles choices than ever available to customers. Two main types of technologies have been brought to market:technologies that require a trade-off in cost / efficiency / utility / performance (e.g. certain electrification technologies) and those with a good cost/benefit tradeoff that do not require customers to choose between the two.

Finally, if customer uptake of fuel efficient vehicles and technologies proves to be insufficient, manufacturers could face the prospect of limiting volume for powertrain options or vehicle lines that negatively impact fleet averages, or even eliminating certain offerings. This approach would

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[228] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 6-1 et seq.
[229] *Id.* at 6-5, 3-2.

limit customer choice and reduce the utility of affected vehicles. In addition, such a scenario would likely lead to inequities in the market and ultimately market disruption if all companies were not forced to use the same strategy.

Positive Professional Auto Reviews Do Not Equate to Customer Acceptance

The Agencies have based their customer acceptance review on a study that relies on the opinion of auto magazine articles and the technology reviews they contain to determine whether or not there are significant problems with the uptake of fuel efficiency technologies. It is not clear if this group of reviewers appropriately represents the average customer's view of fuel efficiency technologies as these magazines often specialize in reviewing performance cars and are more accepting of and familiar with advanced technology. For example, *Car and Driver*'s "10 Best" cars of 2016 includes seven performance cars, and zero fuel efficient models; *Automobile* magazine's "2016 All Stars" includes only performance cars. *Motor Trend* identifies just one "Car of the Year" each year and for the last five years, has not chosen a fuel efficient vehicle. In 2011, when the Chevrolet Volt was released, they did choose the Volt as "Car of the Year" while noting in the review (regarding one of the judges in 2011) "[l]ike all of us on the staff at *Motor Trend*, Chris is an enthusiast, a man who'll keep a thundering high-performance V-8 in his garage no matter how high gas prices go. But he nailed the Volt's place in automotive history: 'If this is the brave new world, then it's an acceptable one.'" It is also unclear if strong conclusions can be made from the sample size studied as only 30% of the technologies are shown to have over 100 evaluations.

One additional concern is the conclusion that if the number of positive evaluations exceeds negative evaluations, the technology is not problematic. For example, the Agencies discuss the two technologies that received the most unfavorable reviews, continuously variable transmissions (51% positive) and stop-start (59% positive) and conclude that "these results suggest that it is possible to implement these technologies without significant hidden costs" (where hidden costs indicate negative customer acceptance). However, it must be noted that in the highly competitive automotive market, it is not always acceptable to use a technology that only half of customers view positively and expect to remain competitive and successful.

The Agencies also state that as the data suggests it is possible to implement new technology and avoid hidden costs, automakers should also be able to improve implementation of these technologies over time. [230] However, as the level of standards increase yearly, there is not significant time to fully vet certain technologies or improve on them before they must either be replaced with something different or supplemented. This cadence will also directly affect customer acceptance.

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[230] *Id.* at 6-12.

Green Auto Loans

The Agencies cite that market innovation has led to the creation of "green auto loans" which "take fuel savings into account in the lending decision." [231] However, the available programs do not reference actually taking the future fuel savings into account when calculating the loan. Rather they offer this as an incentive to attract a particular type of loan applicant. For example, as one of the references provided in the Draft TAR states, while purchasers of certain efficient vehicles can benefit, "[t]he bank benefits as well because a review of its vehicle loan portfolio has shown that shoppers who purchase fuel-efficient autos are more likely to make their payments than consumers with other types of vehicles." [232] Ultimately, most "green auto loans" offer a 0.25% discount for financing certain hybrid or electric vehicles which is equal to or below a similar incentive most banks offer called "relationship discounts" which can offer loan interest rate discounts of 0.25-0.50% for initiating car loans where a customer also holds a checking or savings account.[233]

Critiques of Customer Acceptance Modeling Approach in OMEGA and the Volpe Model

Volpe Model Customer Acceptance

NHTSA addresses assumptions used within the Volpe model related to customer adoption of fuel economy technologies within Chapter 13 of the Draft TAR. [234] In general, the model predicts how manufacturers respond to increasing stringency of fuel economy targets by applying technology throughout the fleet. The Agency further states that the model uses fixed future sales volumes applied by the user as inputs and does not adjust sales as costs or attributes of vehicles generally change over the time period of the simulation.

NHTSA explains that the current Volpe model does not incorporate any type of "dynamic demand response" model to predict how sales of vehicles would change in response to attributes and costs. The Agency explains that Volpe has experimented with a variety of choice models, but that these prototype updates have not been incorporated into the current Draft TAR output. The Alliance requests that if further development of a dynamic demand response model is explored, or is intended to be used for the NPRM, that NHTSA release details of this model beforehand with sufficient time to stakeholders to review and provide comment to such a feature. As explained in Chapter 6 of the Draft TAR, EPA found significant inconsistency between

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[231] Id. at 6-19.
[232] Id. at 6-19, referencing footnote 55.
[233] Examples of these programs may be found at https://welcome.wf.com/greatrateevent/auto.html and https://www.soundcu.com/personal/auto-loans/green-auto-loans/.
[234] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 13-1 et seq.

existing customer choice models and was not able to create a sufficiently robust model themselves to use in the Draft TAR. Coordinating efforts between the Agencies, and including feedback from industry will be critical should a choice model be introduced prior to any subsequent steps in the MTE process.

The Alliance generally agrees that if such a concept can be proven robust and reliable then eventually including customer choice models within the overall Volpe fleet model would be appropriate. This could help illustrate dynamic shifts in the marketplace as the simulated customers evolve their purchase patterns in response to increasing costs. NHTSA speculates throughout Chapter 13 that the price of vehicles may or may not reflect the costs of added technologies depending on how manufacturers price vehicles throughout their line-up.[235] The Agency seems to be indicating that certain segments of customers may not have to pay the full price for technologies if the manufacturers elect to shift pricing on other models such as through cross-subsidization, but no further details as to how such a scheme would work were provided.

The Draft TAR states that NHTSA has been evaluating multiple pricing models to use within the Volpe model, but that the current Draft TAR results use the traditional "pay as you go" approach which fully allocates each individual vehicle's technology cost only to that vehicle.[236] As stated previously with regards to the customer choice model, the Alliance requests early access to any pricing model which may be considered for use in later iterations of the Volpe model used to inform subsequent steps of the MTE.

While the Alliance cannot discuss pricing strategies directly and will leave this to the individual members, in general it is obvious that pricing of models within a fleet and even over the lifetime of each individual vehicle is highly variable and subject to individual considerations by each automaker. However, the output showing technology costs per vehicle individually provides a reasonable estimate of the impact of the standards on costs that a customer could face. There is some belief that premium segments could be priced higher in order to cover the cost of technologies applied to other, possibly lower cost, models where the cost could not be recovered by the manufacturer. However, not all manufacturers have a diverse line-up of vehicles, and some may not offer models with margins that could "absorb" losses on other vehicles. In addition, the Volpe model clearly shows significant technology costs being added to all vehicles across all pricing spectrums. For example, NHTSA claims that the full cost of compliance for passenger cars may approach $2,200 on average; the question of whether or not a low-volume high margin vehicle could cover its own cost, plus the cost of other lower cost vehicles, is speculative. Premium segments are competitive in unique ways; often customers do not value fuel economy in purchasing decisions but instead demand other features, such as high

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[235] *Id.* at 13-8 et seq.
[236] As may be modified by the NHTSA analysis insomuch as it assumes certain manufacturers pay civil penalties in lieu of applying technology.

performance or advanced driver assist systems. It is not to be overlooked that customer demand for non-fuel-economy related technology has led to innovations throughout history by premium brands that have benefitted the entire industry, and the environment in other ways. An example of this is seen in 1991 when (long before regulations required it) Mercedes-Benz designed and built the first ever automotive chlorofluorocarbon (CFC)-free climate control system and eliminated CFCs from the entire manufacturing process. There are also real benefits to society in what these customers seek in terms of advancing safety technology (e.g. driver assistance systems), technology that reduces congestion (e.g. smart navigation), and technologies that reduce distracted driving (e.g. heads-up displays).

In conclusion, as NHTSA moves forward to consider adding customer choice algorithms or producer pricing strategies within future iterations of the Volpe model, the Alliance requests that significant effort is made as early as possible to include stakeholders such as automakers in the process. The magnitude of including either or both of these two macro issues, and how these could affect the consideration of future standards is deserving of a discussion much longer than a 60-day comment period allows.

The "effective cost" method used within the Volpe model attempts to estimate "what manufacturers believe consumers are willing to pay" for fuel economy technology.[237] As explained in the Draft TAR, the effective cost compares the cost of a technology minus the estimated three-year fuel savings (including discount rate) that a customer would expect to see.[238] The effective cost includes an additional calculation, once a manufacturer has achieved compliance, by examining the extent to which additional technology would be applied albeit using only one year of payback. The Alliance understands that NHTSA performed some sensitivity analysis with the Volpe model around this feature and the payback periods. The Alliance is uncertain if it is appropriate to apply two different payback periods for being under- and over-compliant with the standard. It is unclear how customers would know or why the would be concerned with the current compliance position of a manufacturer. It seems that a customer would apply a payback period that is specific to their valuation of fuel savings and not to the compliance position of a manufacturer. In essence, the Volpe model assumes full cost recovery of the technology and does not adjust sales for increases in price.

Economic Theory of Customer Acceptance

Customer acceptance issues center on the question of how customers value fuel economy improvements in new vehicles. The economic literature on this topic is known to be mixed, as the Draft TAR acknowledges.[239] This is not sufficient justification to abdicate any effort at

[237] *Id.* at 13-10.
[238] *Id.* at 13-49.
[239] *Id.* at 10-19.

estimating the impact of higher standards on sales, and as manufacturers planning their business futures, automakers certainly do not have that option. Additionally, customer priorities and preferences, as well as affordability are key factors in customer acceptance.

The Draft TAR Fails to Estimate Sales Impacts

To estimate employment impacts, the Agencies must first determine the degree to which the standards will result in a change in vehicle sales. The Agencies do not make such an estimate in any of the chapters where such an analysis would be expected--neither in Chapter 6: Assessment of Customer Acceptance, nor Chapter 7: Employment Impacts, nor in Chapter 10: Economic and Other Key Inputs Used in the Agencies' Analyses, nor in Chapter 13: Analysis of Augural CAFE Standards.[240] Instead, the Agencies state that, because the standards in place since MY2012 are national in scope, and because of the inability to control for other macroeconomic conditions, there is no way to identify a baseline for measuring the impact on sales.[241]

Despite the many statements about being unable to estimate sales, throughout Chapter 4 of the Draft TAR future vehicles sales are projected.

In Chapter 4, EPA further explains how it adjusted the MY2014 baseline data for segmentation using IHS/Polk[242] and then scaled vehicle sales to AEO2015 levels. [243] But AEO2015 projects 17.2 million light-duty vehicle sales in MY2025, which is almost 800,000 more than what EPA shows as the AEO2015 reference case. EPA states that "[t]he unforced AEO2015 forecast alone does not have the necessary resolution, down to the vehicle segment level, for EPA to perform its analysis." [244] If EPA does not have the "necessary resolution" at the segment level, how did EPA then adjust the AEO reference case downward by 800,000 units? It is not clear if EPA removed or retained heavy-duty Class 2b and 3 vehicles from AEO's light-duty vehicle totals, and whether EPA's final projection includes medium-duty passenger vehicles (MDPVs) or not.

Regardless, the final EPA sales projections for MY2025 in Tables 4.4 and 4.5 (from the MY2014 baseline; with and without the standards) show no significant decrease in sales due to the increased cost of vehicle FE technologies that must be added to comply. Such a "no-decrease" sales projection as shown by Tables 4.4 and 4.5 is difficult to comprehend. Baseline projections of sales in 2025 absent the standards would be expected to be higher than projections of sales with the standards due to the lower price of vehicles. The Agencies have acknowledged a price elasticity for the demand of automobiles – that is, when price goes up, demand (sales) go down. In fact, as the Agencies reported when the standards were originally set, "There is a broad

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[240] *Id.* at 6-2, 6-17, 7-14, 13-94.
[241] *Id.* at 6-2.
[242] *Id.* at 4-12.
[243] *Id.* at 4-12.
[244] *Id.* at 4-12.

consensus in the economic literature that the price elasticity of demand for automobiles is approximately –1.0, meaning that every one percent increase in the price of the vehicle would reduce sales by one percent…”[245] Thus, the Agencies should at least have been able in the Draft TAR to attribute some reduction in vehicle sales to the anticipated increase in purchase price, using Agency projections of increased vehicle costs. It stands to reason that to arrive at a projection of no sales decrease, the Agencies did not make estimates or ignored the impact of, vehicle demand versus price elasticities, customer acceptance, gasoline prices, the economic situation in MY2025, and others. The actual assumptions used, or the values associated with such assumptions, are not clearlyshown in the Draft TAR. In the next steps of the MTE, the Agencies should provide, in detail, the assumptions relied upon in estimating sales in 2025.

The IHS/Polk spreadsheet data from the docket [246] (which assume the standards stay fixed from 2021 onwards) do project a decrease in sales due to the effect of higher gasoline prices, showing a difference of 1.2 million vehicle sales between the projections of EPA high gasoline prices and EPA low gasoline prices. [247] Since the IHS/Polk projections hold standards constant at 2021 levels, they do not provide information on what sales might be with the application of MY2025 standards.[248] The following graph (Figure E-9) plots these sales projections from the IHS/Polk spreadsheet:

[245] “2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards.” 77 Fed. Reg. 2012 FRM 62623 at 63102. (October 15, 2012).
[246] Docket ID EPA-HQ-OAR-2015-0827-0403.
[247] *Id.*
[248] *Id.*

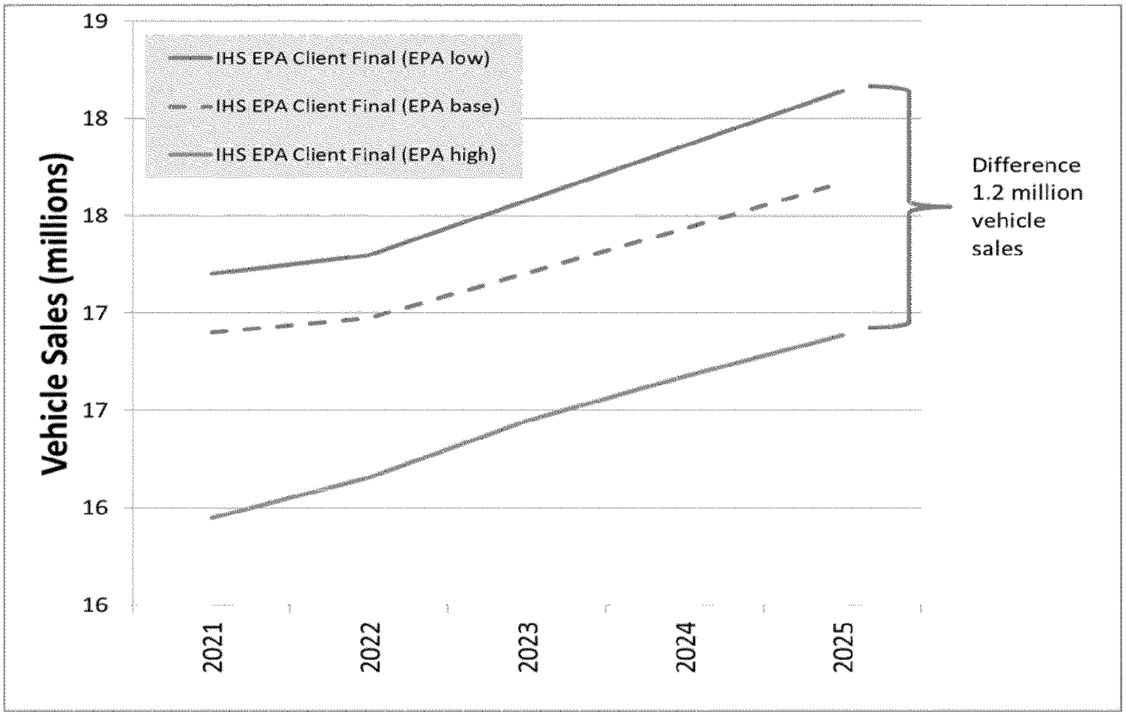

Figure E-9: Chapter 4 IHS/Polk Sales Projections from the Draft TAR[249]

Outside consultants have made baseline projections of sales in MY2025 absent the standards and these projections were available to the Agencies to use in the Draft TAR. For instance, the June 2011 version of the CAR 2025 Jobs report[250] makes a projection of a baseline sales level of 17.9 million vehicles sold in 2025 absent the 2009-2025 standards. A more recent September 2016 version of the CAR 2025 Jobs report[251] projects a baseline sales level of 18.64 million vehicles sold in MY2025 absent the MY2017-2025 standards. The IHS/Polk data projects sales of 16.9 million to 18.1 million in 2025, absent the standards.[252] We believe all of these "absent the standards" sales estimates to be in line, since the CAR's estimate of 18.64 million sales[253] assumes no additional government fuel economy mandates for the 2017-2025 period, not just the 2022-2025 period as the IHS/Polk estimates do.

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[249] *Id.*
[250] "The U.S. Automotive Market and Industry in 2025." Center for Automotive Research. June 2011. 40.
[251] "The Potential Effects of the 2017-2025 EPA/NHTSA GHG/Fuel Economy Mandates on the U.S. Economy." Center for Automotive Research. September 2016. 36.
[252] Docket ID EPA-HQ-OAR-2015-0827-0403.
[253] "The Potential Effects of the 2017-2025 EPA/NHTSA GHG/Fuel Economy Mandates on the U.S. Economy." Center for Automotive Research. September 2016. 36.

Affordability

In December 2015, Kelly Blue Book reported the estimated average transaction price for light-duty vehicles in the United States had reached an all-time high of $34,428.[254] As vehicle prices have risen over time, and competing demands on incomes such as health care costs and other personal consumption expenditures have also expanded, customers are making various tradeoffs to maintain their transportation needs, but data suggest they are unwilling, or unable, to increase the share of their budgets allocated to transportation. The share of gross domestic product (GDP) spent on new vehicle purchases has held relatively flat, or even declined slightly outside of the financial crisis period. Customer spending on new vehicles, as a percentage of GDP, averaged 1.8% in the period from MY2000 to the present and appears to have plateaued at this level recently (Figure E-10) (slightly below its pre-crisis run rate).

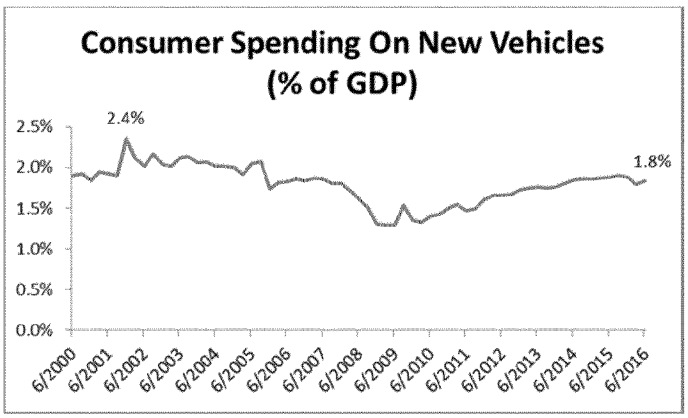

Figure E-10: Customer Spending On New Vehicles As Percentage of GDP, 2000-2016[255]

Over the past 15-20 years, as new car prices increased, interest rates dropped dramatically and remained low, as illustrated in Figure E-11, making it possible for customers to continue buying new light-duty vehicles. In essence, the increased vehicle cost was offset by the low cost of capital. In addition, average loan terms have lengthened significantly, approaching seven-year terms. Customers also seek affordability through the leasing mechanism to create an affordable monthly payment. Leasing across all new vehicle segments has increased from 27% in Q2 2015

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[254] Record New-Car Transaction Prices Reported In December 2015, According To Kelley Blue Book. Kelley Blue Book. Accessed September 26, 2016. http://mediaroom.kbb.com/record-new-car-transaction-prices-reported-december-2015

[255] New Motor Vehicle Expenditures data from Bureau of Economic Analysis, "Real PCE New Motor Vehicle Expenditures 2009 Chained Linked Dollars" (Table 2.4.6U. Personal Consumption Expenditures by Type of Product) and "Real PCE New Motor Vehicle Leasing Expenditures 2009 Chain Linked Dollars "(Table 2.4.6U. Personal Consumption Expenditures by Type of Product). GDP data from Bureau of Economic Analysis, Real GDP 2009 Chain Linked Dollars (Table 1.1.6). Bureau of Economic Analysis.

to 31% in second quarter 2016. [256] This has allowed customers to keep their monthly payments affordable during a period of stagnant household income.

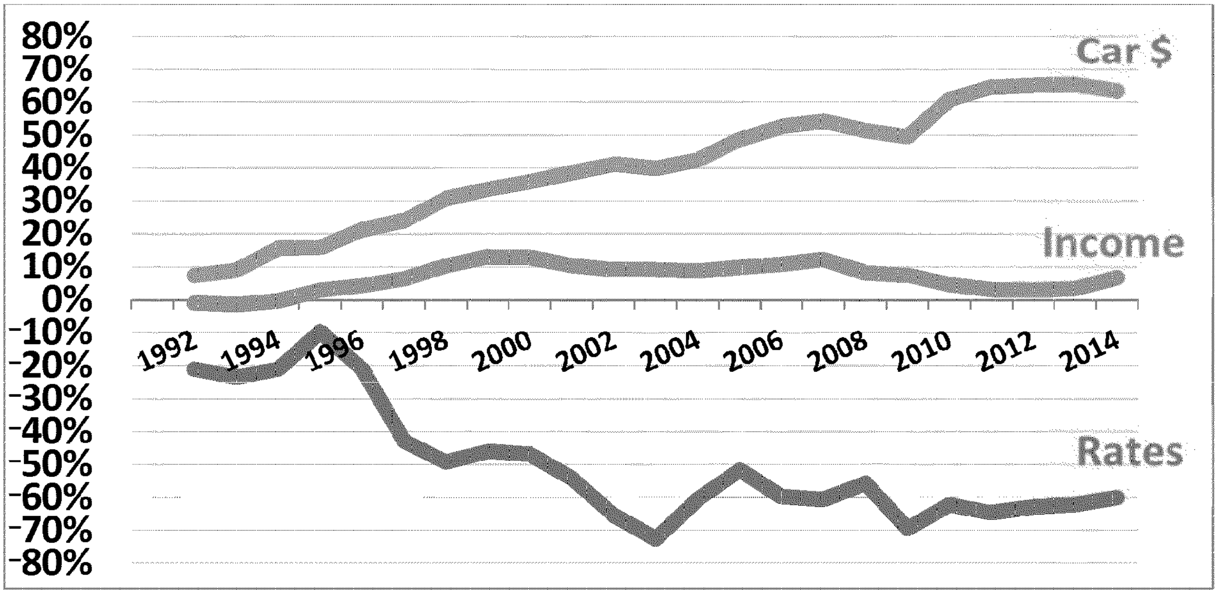

Figure E-11 Percent Change of Median Household Income, New Car Prices, And Interest Rates: 1991 Baseline

For the MTE, the Agencies (as well as Congress, states, and the general public) must evaluate how the slowdown in growth of disposable personal income,[257] combined with the Federal Reserve's recent decision to begin increasing interest rates (thereby increasing the cost of capital), will impact customers' ability to afford the increasingly expensive technologies needed to meet the future CAFE and GHG standards. This analysis must take into account that other regulations will simultaneously have an impact on vehicle production costs and achievable fuel economy. If customers have difficulty affording the cost of new technologies required for compliance, they may decide to hold onto their current vehicles longer or purchase from the used vehicle market. In either case, the "virtuous cycle" of fleet turnover with safer and more fuel-efficient vehicles is stalled and the standards do not achieve their anticipated benefits.

One accommodation customers can make in the face of rising vehicle transaction prices is indeed to hold their existing vehicles longer before replacement, which is increasingly possible with ongoing durability improvements. This translates into a lower percentage of households buying vehicles in any given year, which has been on a downward trend since 2000, and has only

[256] "State of the Automotive Finance Market." Experian Automotive. 2016. 11. Accessed September 20, 2016. http://www.experian.com/assets/automotive/quarterly-webinars/2016-Q2-SAFM.pdf.
[257] United States Disposable Personal Income. Trading Economics. Accessed September 26, 2016. http://www.tradingeconomics.com/united-states/disposable-personal-income.

recently recovered to its pre-financial crisis rate (Figure E-12). Importantly for FE standards, this also means that new, more fuel efficient technologies, take ever longer to make it into the fleet. Additional pressure on new vehicle prices due to fuel economy standards, whether those features are valued by customers or not, will further extend vehicle holding periods and technology penetration rates.

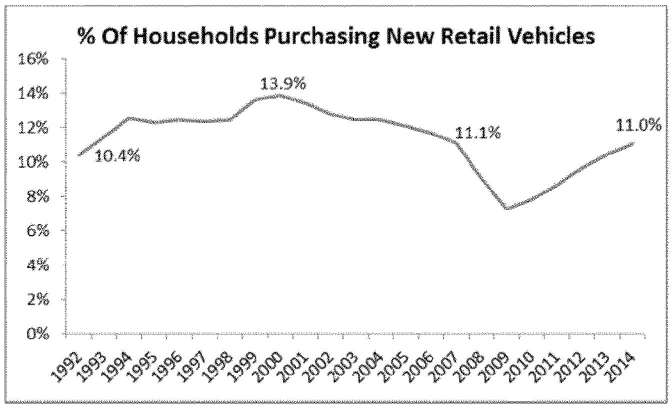

Figure E-12: Percentage of Households Purchasing New Retail Vehicles, 1992-2014[258]

These developments also push more households into the used vehicle market, leaving a gap between households able to afford a new vehicle versus the population as a whole. According to Steven Szakaly, Chief Economist of the National Automobile Dealers Association, the average new car buyer is 51.7 years old and earns about $80,000 per year, while the average age of the population is 36.8 years and the median income is roughly $50,000. As stated above, this implies that lower income households, with monthly expenditures most sensitive to changes in fuel prices, are also the least able to afford more fuel efficient vehicles.

Finally, in the years to come, the financing environment for new vehicles is unlikely to be as favorable as its current state. Interest rates remain near historic lows, but are on a path to increase according to published projections by the members of the rate-setting Federal Open Market Committee of the U.S. Federal Reserve.[259] Lending standards for new auto loans have begun to tighten (Figure E-13), as shown by the latest Senior Loan Officers Opinion Survey (SLOOS), and it is unclear how much further vehicle loan terms can be extended without putting too many customers into a prolonged negative equity position on their new vehicle loan. None of these factors appear to have been taken into account by the Draft TAR.

[258] Vehicle sales data from FRED (Federal Reserve Economic Data), Federal Reserve Bank of St. Louis. Number of households from United States Census Bureau, Families and Living Arrangements, Table HH-1.

[259] "Economic projections of Federal Reserve Board members and Federal Reserve Bank presidents under their individual assessments of projected appropriate monetary policy, September 2016." Federal Open Market Committee. September 21, 2016. Accessed September 26, 2016. https://www.federalreserve.gov/monetarypolicy/files/fomcprojtabl20160921.pdf.

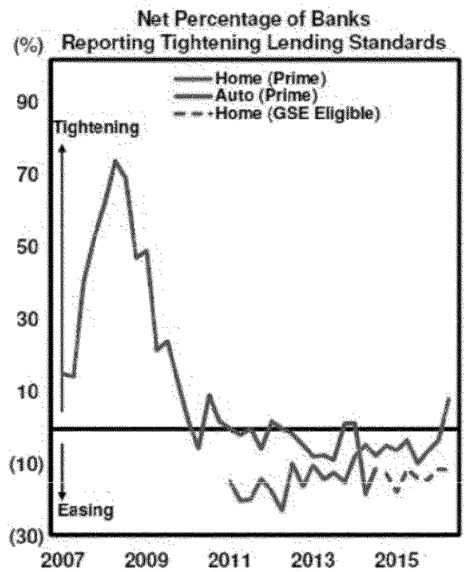

Figure E-13: Trends in Home and Automotive Lending Standards[260]

Customer Priorities and Preferences

A key component of the MTE should be an assessment of customer priorities and preferences when making a new vehicle purchase.

Strategic Vision conducts a comprehensive post-purchase survey of over 300,000 new car buyers each year, investigating the motivations driving customer choices. The 2015 NAS Report acknowledges that Strategic Vision provides "the most reliable information about consumer preferences."[261]

Based on information gathered b y Strategic Vision, Figure E-14 shows that interest in fuel efficiency must be considered contextually. while 32% of buyer s assert "fuel economy is a leading consideration," superior handling, ride comfort and a q uiet interior are all attributes that respondents considered more important.

[260] Federal Reserve Senior Loan Officer Opinion Survey
[261] "Cost, Effectiveness and Deployment of Fuel Economy Technologies for Light-Duty Vehicles." National Academy of Sciences, National Research Council to the National Academies. 2015. 325.

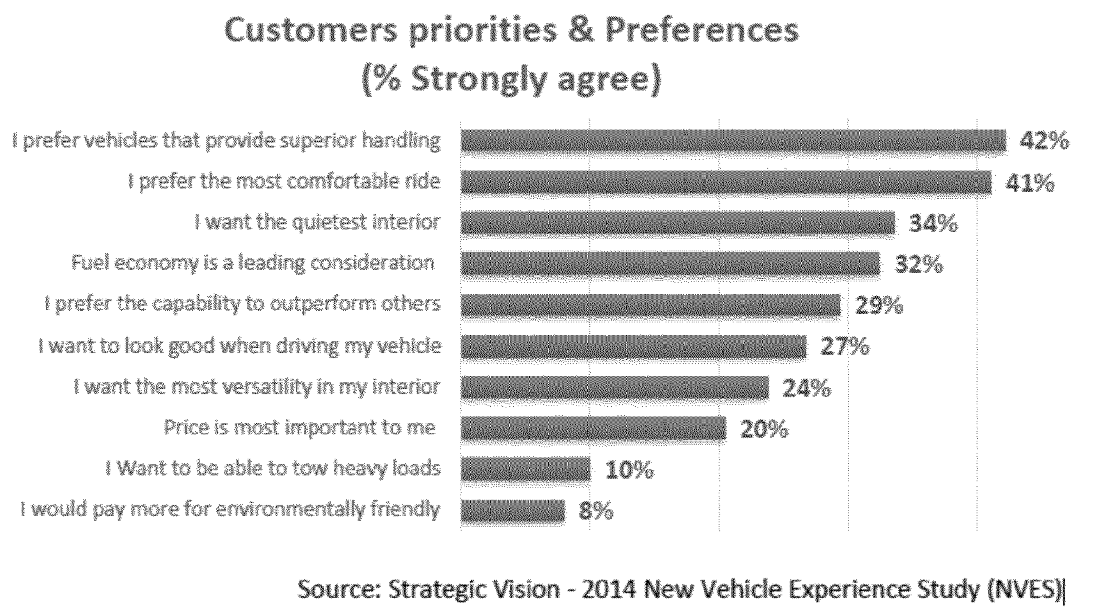

Figure E-14: Customer Priorities and Preferences

Customer Preferences and Willingness to Pay for Fuel Efficient Technologies

Customers choose vehicles to perform specific functions and select powertrains that have sufficient performance to meet those functions. Although customers prefer improved fuel economy when there are not tradeoffs against performance or price, the decision of which vehicle and powertrain to select becomes more complex when these tradeoffs must be considered. For example, if a powertrain option does not provide the towing and hauling capacity that a customer needs to accomplish the intended use of their vehicle, the customer may select a more capable powertrain. Similarly, customers may select a taller vehicle to comfortably accommodate their family and cargo. In both of these examples, the high fuel economy option within a particular vehicle model or class is not an option for the customer.

Furthermore, the Agencies modeled compliance strategies including downsized turbocharged engines, representing 33% of the EPA's modeled 2025MY fleet.[262] NHTSA modeled implementation of downsized turbocharged engines in 19% of passenger cars in MY2030 and 35% of trucks.[263] In the market, however, there are limits to the extent of downsizing and the potential performance loss that customers will accept. To entice customers to select a downsized turbocharged powertrain, fuel economy improvements alone are insufficient. Manufacturers

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[262] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 12-33, Table 12.41.
[263] *Id.* at 13-62, Table 13.30.

often must offer increased performance compared to baseline naturally-aspirated engines in the form of increased horsepower, torque, payload, and/or towing capability.

Four Wheel Drive / All Wheel Drive System Considerations

During the MTE, the Agencies were tasked with reviewing several independent relevant factors that impact the goals of this program. One area that has not been reviewed, but which touches on many of these factors is the fuel economy decrease associated with 4WD / AWD vehicles. This overlaps with many of the factors the Agencies deem relevant to the MTE, including impacts on fleet mix and safety; powertrain improvements for gasoline and diesel engines; and cost, availability, and customer acceptance of technologies to ensure compliance with the standards.

Impacts on Fleet Mix

Many areas of the country see yearly inclement weather and or are rural with a high percentage of dirt roads, which the Alliance believes can trigger 4WD / AWD preferences over 2WD. To determine whether or not registrations of 4WD / AWD vehicles trend towards states with either high snowfall or dirt roads (or both), the Alliance performed a comparison of available weather, road condition, and registration data. Registration data is based on new vehicle registrations in MY 2015 IHS Markit data for the U.S. Light Vehicle fleet (which includes passenger cars and light trucks/vans/SUVs in the GVW 1,2,3 weight class) and was separated by state for 2WD and 4WD / AWD.

The study took the top five most populous cities available for each state, and using snowfall data for these cities that originated from NOAA's National Climatic Data Center's "1981-2010 Climate Normals."[264] This study calculated a population-weighted snowfall average value for each state. The snow data used is based on a 30-year average and therefore does not include any effects of recent snow storms in certain areas that could have affected sales in certain states.

This study also examined the percentage of unpaved roads in each state. The data originated from the Federal Highway Administration which tracks the total miles of paved and unpaved roads for all major collectors, minor collectors, and local roads.[265] This study added all of the miles of paved and unpaved subtotals from each road category and divided by the total miles of road in each state to arrive at percentage of unpaved roads by state. Certain mountainous states are noted in the Figure E-15, which may also affect purchasing decisions, but no attempt was made to find any correlations. Furthermore, state activities such as rate of agriculture may also impact 4WD / AWD registrations (e.g. in Texas, as is shown in Figure E-15).

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[264] National Climatic Data Center. NOAA's 1981-2010 Climate Normals. National Oceanographic and Atmospheric Administration. Accessed September 26, 2016. https://snowfall.weatherdb.com/.

[265] U.S. Department of Transportation, Federal Highway Administration, Highway Statistics (Washington, DC: Annual issues), table HM-51. Accessed September 26, 2016. http://www.fhwa.dot.gov/policyinformation/statistics/2014/hm51.cfm.

Figure E-15 below shows the compa rison of average snowfall, per centage of dirt road, and registrations of 2WD / 4WD / AWD vehicles. The Alliance believ es that the aggregation of these data shows that for customers encountering either substan tial snowfall each year, or a high percentage of dirt roads in their area, or both, there is corre lation to registrations of 4WD / AWD vehicles. With few exceptions, states with high snowfall show a strong relationship to 4WD / AWD registrations. One exception below could be New York. Howe ver, using a population weighted snowfall in a highly urbanized area that has a signifi cant public transportation and likely has a lower vehicle ownership rate, could outweigh the h igh snowfall effects of rural New York State customers.

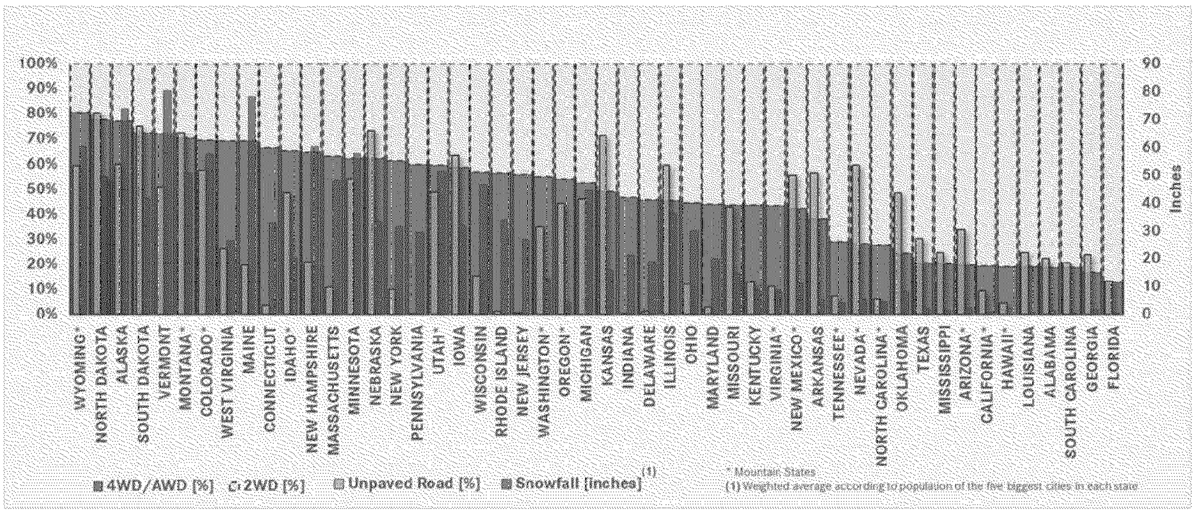

Figure E-15: 2WD / 4WD / AWD Sales by State v. Snowfall and Unpaved Road Conditions by State[266]

Impacts on Safety

- U.S. Department of Transportation (DOT) statistics show that 44 % of all weather-related accidents occur due to winter conditions.[267]
- In addition to U.S. citizens living in areas with harsh winters , consideration must also be given to those living in rural areas where 31.5% of all VMT occ urs and where the daily VMT is also 30% greater than in urban areas – these drivers amore likely to encounter dirt roads as over one-third of roads in America still remain unpaved.[268,269]

[266] Analysis completed by the Alliance based on data from: 1) the U.S. Federal Highway Administration http://www.fhwa.dot.gov/policyinformation/statistics/2014/hm51.cfm, 2) https://snowfall.weatherdb.com/ 3) State volumes for drivetrain type provided by IHS Markit. IHS Markit data used with permission.

[267] "How Do Weather Events Impact Roads?" U.S. Deparment of Transportation. Accessed September 26, 2016. www.ops.fhwa.dot.gov/weather/q1_roadimpact.htm.

[268] U.S. Department of Transportation, Federal Highway Administration, Highway Statistics (Washington, DC: Annual issues), table HM-51. Accessed September 26, 2016. http://www.fhwa.dot.gov/policyinformation/statistics/2014/hm51.cfm.

- Footprint standards do not consider driving conditions customers encounter daily or frequently and their resulting choice in vehicle drivetrain selection.

Powertrain Improvement for Gasoline and Diesel Engines

Powertrain improvements can never bring parity between 2WD and 4WD / AWD systems in terms of efficiency. Therefore this functionality must be considered as a unique vehicle efficiency constraint and not continually viewed as a penalty for which customers must pay.

Cost, availability, and customer acceptance of technologies to ensure compliance with the standards

- Customers must value the utility and safety benefits of 4WD / AWD enough to pay the added premium, which can be well upwards of $1,500, and forgo the loss of fuel efficiency as a result because 4WD / AWD systems add complexity and weight to the vehicle.
- In the absence of a CO_2 offset for 4WD / AWD systems, customers could be forced to purchase additional technologies that offset some or all of the fuel economy difference between a two-wheel drive and four-wheel drive version of a vehicle. The price increases associated with the added technology may result in customers being priced out of purchasing the added safety associated with 4WD / AWD.

A precedent to Agency recognition for the need to distinguish the utility of 4WD / AWD systems and avoid penalizing customers purchasing this feature can be found in the Agencies' heavy-duty GHG program. In that rule, an adjustment for 4WD vehicles was included. This was done to account for the fact that these systems are critical to enabling off-road heavy-duty work applications and because they add significant weight to the vehicles. It does not make sense for a similar factor to be excluded from the light-duty program, where purchase of this feature can be clearly seen to be unrelated to increased performance. Rather, sales data shows the 4WD / AWD system to be an essential feature in terms of both added safety and utility to customers in areas of the country with harsh winters. The cost and complexity of a 4WD / AWD system is too great for automakers to install as a way to gain relief from the standards. Removing the penalty on 4WD / AWD vehicles will ensure the Agencies honor their intent of preserving consumer choice "—that is, the standards should not affect consumers' opportunity to purchase the size of vehicle with the performance, utility and safety features that meets their needs."[270]

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[269] "How Do Weather Events Impact Roads?" U.S. Department of Transportation. Accessed September 26, 2016. www.ops.fhwa.dot.gov/weather/q1_roadimpact.htm..

[270] "EPA and NHTSA Set Standards to Reduce Greenhouse Gases and Improve Fuel Economy for Model Years 2017-2025 Cars and Light Trucks." U.S. Environmental Protection Agency. EPA-420-F-12-051. August 2012. 2. Accessed September 26, 2016. https://www3.epa.gov/otaq/climate/documents/420f12051.pdf.

Other Relevant Factors

Environment Canada has historically aligned with the U.S. federal GHG emissions program. This can, however, lead to problems due to differing market conditions where demands in Canada as compared to the U.S. can result in unintended consequences for Canadian customers. Environment Canada has worked with the Agencies to study the emissions implications of improvements in AWD systems, presumably because the rate of adoption of AWD / 4WD vehicles is so much greater due to Canada's colder climate, winter driving conditions, and terrain. Environment Canada had considered greater flexibility for AWD / 4WD vehicles in the past to align with Canadian customers' needs. However, the desire for harmonization with the U.S. program was more important at that time. More time is needed to review and discuss the results of this AWD / 4WD study and its conclusions on what is and is not possible for AWD / 4WD system efficiency improvements.

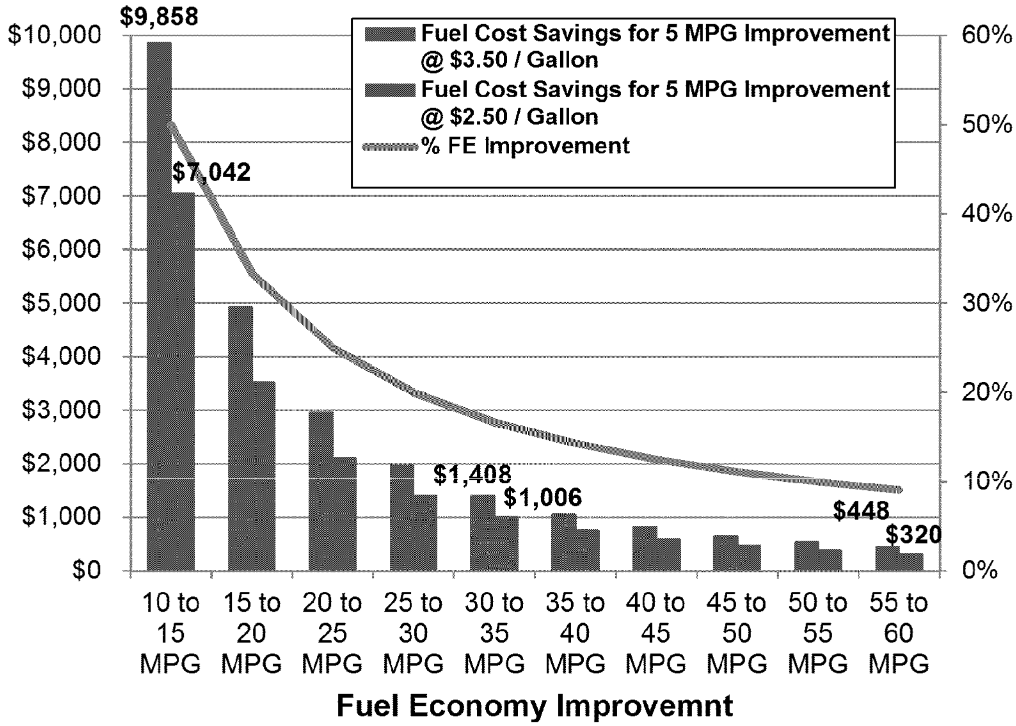
Additional Functionality

An additional challenge to customer acceptance of fuel efficiency technology is the growing popularity of advanced technology such as connectivity, infotainment, and driver assistance features which are undergoing a period of rapid change and innovation across the industry. New features are being offered, such as embedded modems, allowing control of certain vehicle features by smartphone app, while advanced driver assistance systems such as lane-keeping systems and adaptive cruise control are expanding beyond the premium segment. These features are growing in availability and demand and will compete with fuel efficiency technology for incremental vehicle spending by customers.

Not all advanced technologies such as driver assistance or coaching come absent additional fuel efficiency benefits as advancements have enabled most automakers to include significant driver feedback systems which monitor fuel efficiency to encourage the driver to ultimately use less fuel. Unfortunately, in the 2012 FRM discussion surrounding this type of technology, the Agencies seemed unwilling to consider these technologies for off-cycle credits. The unintended consequence of this is that automakers may not be able to continue to pursue technologies that do not provide certainty in supporting vehicle compliance.

Fuel Economy Savings Are Reduced for Highly Efficient Vehicles

Customers that choose a more efficient vehicle will see the cost to benefit ratio decrease as fuel economy increases. This effect is more pronounced as fuel costs decrease. Customer willingness to pay for improved fuel economy diminishes as fuel economy improves and fuel savings decrease (Figure E-16).



Note: assumes 6.5 years of ownership and 13,000 miles driven per year.

Figure E-16:Fuel Savings with Better Fuel Economy

Adoption of Advanced Fuel Efficiency Technology

Adoption by customers of fuel economy technology under the MY20 12-2016 GHG and FE standards has been slower than a nticipated for many technologie s, particularly those that are viewed by the customer as new technologies, DCTs, strong hybrid s, and mild hybrids. These technologies can have a noticeable impact on vehicle aspects su ch as acceleration, braking, and shifting.

DCTs shift more suddenly than traditional planetary gear-based automatic transmissions with torque converters, whic h is particularly noticeable when accele rating from a stop and has led to drivability concerns from customers. Although DCTs have had wider customer adoption in other markets with higher usage of manual transmissions, U.S. custome rs are accustomed to the smooth, gradual shift enabled by a torque converter.

Novation Analytics conducted a study of technology deployment f or MY2012-2015 vehicles including more than 1,400 vehicl e models and subconfigurations for the MY2015 based on vehicle data submitted by manufacturers to EPA.[271] Actual implementation for MY2012-2015 vehicles was compared to the Volpe model projections from the 2010 FRM.

In the Volpe forecast from the 2010 FRM, DCTs were expected to be implemented in 69% of light-duty vehicles by MY2015, increasing to 76% of the fleet in MY2016.[272] According to the Novation Analytics study, actual fleet implementation in MY2015 was only 2.8%, a decline from MY2012.[273] In the Draft TAR, NHTSA modeled only 7% share for DCT in MY2021 for passenger cars and 3% for light trucks, while transmissions with seven or more speeds and CVTs were modeled at 51% share for passenger cars and 64% for light trucks.[274] Similarly, EPA expanded the definition of advanced transmissions to allow greater penetration of seven or greater speed transmissions and CVTs.

The experience with DCTs, and the Agencies' subsequent adjustment in the Draft TAR to assume significant penetration of seven or more speed planetary gear-based transmissions and CVT, demonstrates that customers may not accept the assumed technologies that were modeled by the Agencies to provide the most cost-effective fuel efficient improvements, particularly when there are noticeable impacts to drivability.

Similarly, according to the Volpe forecast from the 2012 FRM, mild hybrids were expected to represent 24% of light-duty vehicles in MY2015, but the actual share did not exceed 0.1% from MY2012-2015 according to the Novation Analytics Baseline Study.[275] Customers did not broadly adopt market offerings that were available during this timeframe. The Agencies' updated analysis in the Draft TAR again projects significant expansion of mild hybrids, reaching 24% share of MY2030 passenger cars according to NHTSA[276] and 10% of MY2025 cars according to EPA.[277] EPA modeled 27% of MY2025 trucks as mild hybrids, leading to a total fleet penetration of 18%.[278] The past experience with mild hybrids compared to earlier projections demonstrates that the Draft TAR forecasts may be difficult to achieve as customers are hesitant to embrace new and unfamiliar powertrains.

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[271] "MY 2015 Baseline Study," Novation Analytics. September 2016. 8. Attached as Attachment 10.
[272] CAFE Compliance and Effects Modeling System: The Volpe Model. Version 2010 Final Rule for Model Years 2012-2016 Passenger Cars and Light Trucks. National Highway Traffic and Safety Administration. Accessed September 26, 2016. http://www.nhtsa.gov/Laws+&+Regulations/CAFE+-+Fuel+Economy/cafe-volpe-model.
[273] "MY 2015 Baseline Study," Novation Analytics. September 2016. 40.
[274] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 13-63 and 13-69, Figures 13.31 and 13.35.
[275] "MY 2015 Baseline Study," Novation Analytics. September 2016. 41.
[276] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 13-64, Figure 13.32.
[277] *Id.* at 12-33, Table 12.41.
[278] *Id.* at 12-33, Table 12.41.

Hybrid and Plug-In Electric Vehicles

Limited Growth of Electrified Vehicle Sales

Electric vehicle adoption is an important issue related to compliance with the MY2022-2025 GHG and FE standards. As is described in these comments, automakers are expected to rely on a greater share of hybrid and plug-in electric vehicles to comply with the standards than is projected by the Agencies in the Draft TAR. However, the current electric vehicle (EV) buying audience is limited and lacks natural demand. As shown in Figure E-17, PHEV and BEV sales remain under 1% of industry sales, while HEV sales have stagnated around 2% of the market despite being a technology available for almost two decades. Customers have continued to prefer traditional gasoline-powered vehicles. This may be due to perceived concerns related to adapting to new technologies, availability of charging infrastructure, and increased costs for vehicle purchase and battery replacement. We find that with the combined bundle of attributes offered by vehicles available today, gasoline vehicles continue to be most attractive to customers and there is a significantly lower willingness to trade-off to EV technology.

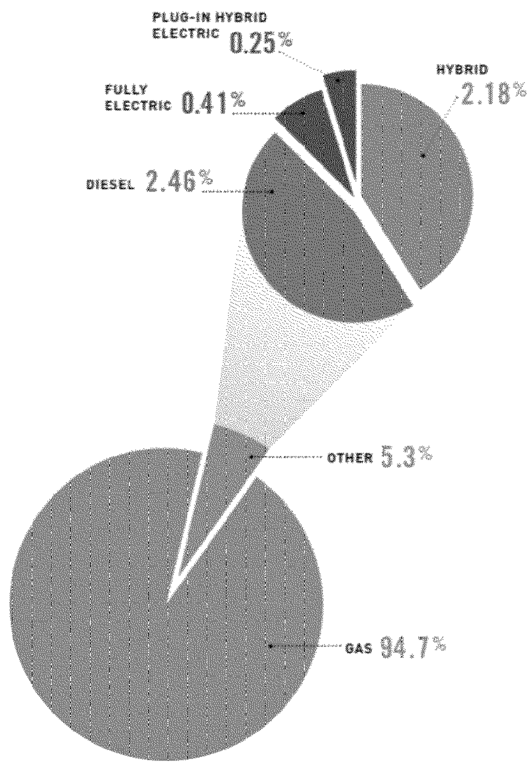

Figure E-17: 2015 Market Share by Powertrain Type[279]

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[279] WardsAuto Fuel Economy Index 2015 State of the Industry.

The Alliance respectfully disagrees with the Agencies' sensitivity analyses conclusions that fuel prices do not impact technology penetrations nor affect fleet electrification.[280] In the Alliance's view, recent experience demonstrates that gasoline price is a significant influencer on EV sales, which are defined here to include battery electric, hybrid electric, fuel cell, and plug-in hybrid electric vehicles. Since 2013, EV industry share in the US has declined from 4% to 2.7% by the end of 2015, according to IHS Markit. Figure E-18 presents the industry share of EV registrations compared to gas prices. The Alliance believes this data demonstrates that the shift in EV registrations mirrored the trend in gas prices over this timeframe, as car buyers placed a lower priority on fuel savings. As the Agencies have recognized the AEO2015 fuel prices, they have noted that the fuel price reference case indicates that prices will remain under $3/gallon through 2025, which the Alliance believes will continue to impact EV sales.

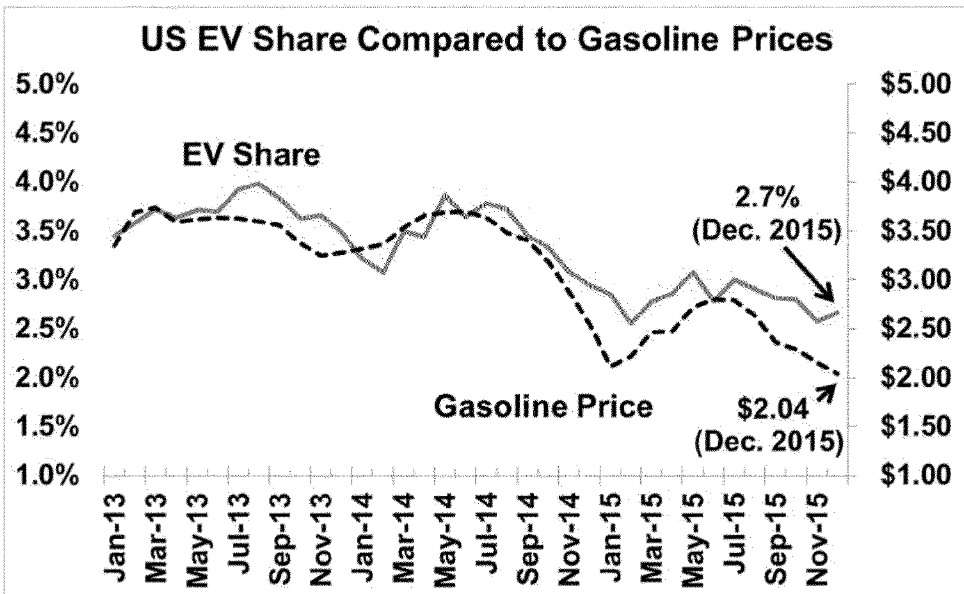

Figure E-18: EV share based on IHS Markit total U.S. new light vehicle registrations (cars and trucks) for each of the years shown for BEVs, PHEVs, Fuel Cell Vehicles and HEVs. Gasoline prices sourced from U.S. EIA.[281]

Decaying residual values further erode the value proposition to EV intenders. Low gas prices have exacerbated this trend as overall demand for EVs has decreased. Kelley Blue Book projected the 36-month residual value of hybrid and plug-in electric vehicles sold in the first two months of 2016 as 29.5%, a decline of 4.1 percentage points from the prior year.[282] If other

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[280] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 12-40.
[281] IHS Markit and U.S. EIA - Used with permission of IHS Markit
[282] *Automotive News*, Sawyers, Arlena (2016). "Cheap gas hits hybrid, EV residuals." Accessed September 15, 2016. http://www.autonews.com/article/20160130/OEM05/302019987/cheap-gas-hits-hybrid-ev-residuals.

factors were responsible for the decline in non-premium EV residual values, this trend would be expected to be apparent in the residual values of all new vehicles. However, according to the National Automobile Dealers Association (NADA), hybrid and plug-in EVs depreciated at 25-35% in 2015, compared to an average of 16.5% for non-EV cars and trucks.[283] This demonstrates that non-premium EVs were uniquely affected by the decline in gas prices and changing customer preferences. Figure E-19 shows the dramatic difference in depreciation between an electric Nissan Leaf and its comparable counterpart gasoline vehicle, the Nissan Versa.

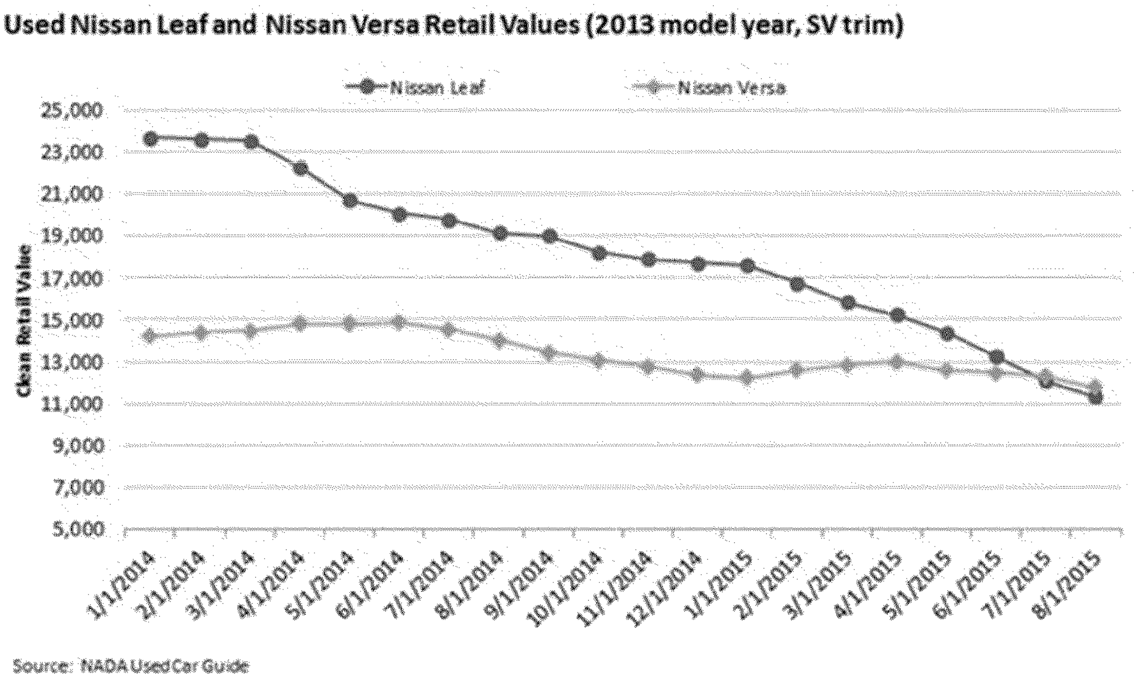

Figure E-19: Used Nissan Leaf and Nissan Versa Retail Values (MY2013, SV Trim)[284]

Reduced residual value compared to gasoline models is another factor limiting customer demand for non-premium EVs.

The low gas price environment has reduced expected cost savings and payback from driving a hybrid or plug-in electric vehicle, while residual values for these vehicles have also decreased in tandem with gas prices. The combined effect of these factors significantly reduces the value proposition for electric vehicles, and EV sales have declined as a result. Low fuel prices and the resultant shift in customer demand materially affect the ability of manufacturers to comply with

[283] *Id.*
[284] Electric Vehicle News: EV Roadmap 8 Conference. National Automobile Dealers Association. Accessed September 26, 2016. http://www.nada.com/b2b/NADAOutlook/UsedCarTruckBlog/tabid/96/entryid/754/electric-vehicle-news-ev-roadmap-8-conference.aspx.

both the GHG and the ZEV regulations–reducing not only future sales, but also sales over the last few years. But for the low fuel prices and lackluster customer demand, automakers would have accrued GHG and ZEV credits for use in future years when requirements dramatically increase. The Agencies should study the impact of low gasoline prices on EV residual values, the impact of residual values on customer acceptance of EVs (particularly for non-premium EVs that represent a broader portion of the market), and the impact these have on automakers' ability to comply with the regulations.

Manufacturer Efforts to Promote Electrification

The limited market for EV sales is not for lack of manufacturer research and development, investment, advertising, or customer incentives. As an example, General Motors released an advertisement for the redesigned Chevrolet Volt six months before the car was set to release. Other automakers such as BMW Group, Ford Motor Company, and Toyota have featured their EVs in clever prime-time (including Super Bowl) television advertisements.[285,286] Manufacturers have invested significant resources to develop and sell these vehicles; growing the market can mean increasing sales and reducing incentives which is the desired outcome. Manufacturers have reduced the suggested retail prices of EV offerings and increased incentives in response to the risks posed by customer adoption trends. Increased manufacturer incentives have yet to offset the share decline and motivate non-premium EV customers, however. As shown in Figure E-20, although transaction prices in the overall industry are trending upward, mainstream (i.e. non-premium) plug-in EV prices declined 9% from January 2015 to August 2016 as manufacturers increased incentive spending on non-premium EVs.

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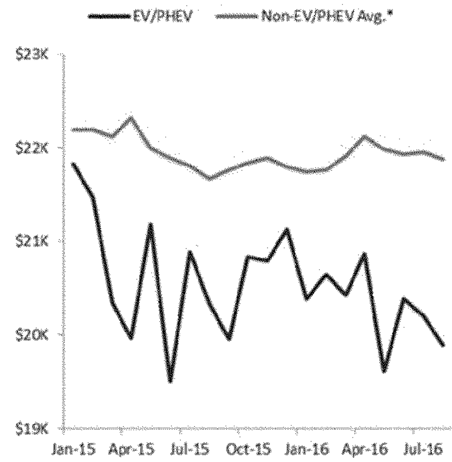
[285] *See* 6 Electric Vehicle Ads That Make a Brilliant Case for EVs. Autos Cheat Sheet. Accessed September 26, 2016. http://www.cheatsheet.com/automobiles/6-electric-vehicle-ads-that-make-a-brilliant-case-for-evs.html/?a=viewall.

[286] 2016 Chevrolet Volt TV Ad Released 6 Months Before Car. Green Car Reports. Accessed September 26, 2016. http://www.greencarreports.com/news/1096475_2016-chevrolet-volt-tv-ad-released-6-months-before-car.



*Comparison includes only those segments where BEV/PHEV segments exist

Figure E-20: Average Customer-Facing Transaction Prices for Mainstream Plug-In Electric Vehicles and Other Vehicles, 2015-16[287]

Automakers offer significantly higher incentives on plug-in vehicles compared to non-EVs in the same segments, and incentive spending for plug-in vehicles has increased since 2015 (Figure E-21). Automaker incentives for mainstream plug-in EVs average more than $8,000. Combined with the federal tax credit for EV purchases, total incentives for mainstream plug-ins average more than $12,000. Increased OEM incentive spending has contributed to declining average customer-facing transaction prices in the segment, as is described above.

[287] J.D. Power & Associates - Power Information Network. Used with permission of J.D. Power.

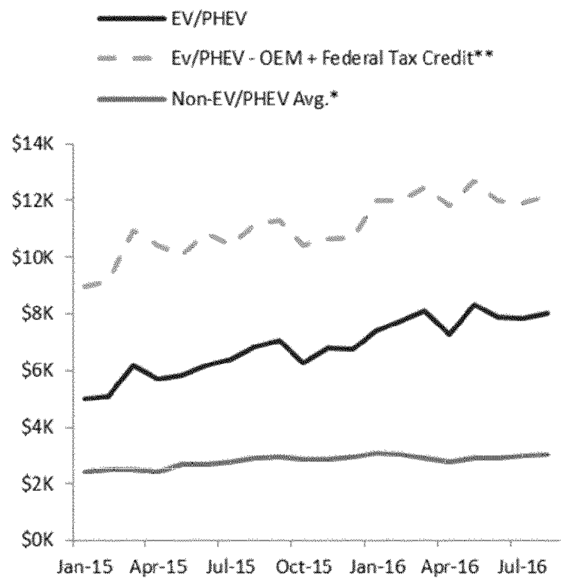


Figure E-21: Average Incentive Spending and Federal Tax Credit Benefits For Mainstream Plug-In Electric Vehicles and Non-EVs, 2015-2016[288]

The 2016 Lincoln MKZ offers a relevant example for customer acceptance of hybrid electric vehicles. The 2016 MKZ was offered with a variety of powertrains including a 2.0L Hybrid, 2.0L EcoBoost and 3.7L V6. Lincoln priced the 2.0L Hybrid and 2.0L EcoBoost variants at identical retail pricing, providing the opportunity for customers to choose a hybrid without incurring additional cost, even at the base price. If customers are motivated by fuel savings, most would be expected to choose the hybrid to reduce fuel costs without increasing their upfront cost. Figure E-22 shows that only 30% of MKZ customers selected the hybrid, while 70% chose a gasoline powertrain. Customers did not elect to purchase the hybrid powertrain, possibly due to the slightly decreased performance found with the hybrid powertrain, uncertainty about new technology, or preference for the familiar driving experience of a traditional powertrain. The Lincoln MKZ sales results repr[illegible] experiment in customer preference for hybrid electric vehicles compared to gasoline powertrains on the same vehicle model at the same price. The results, with hybrid share at less than half the share of gasoline, demonstrate that manufacturers face challenges in marketing EVs even when offering significant incentives.

[288] J.D. Power & Associates - Power Information Network. Used with permission of J.D. Power.

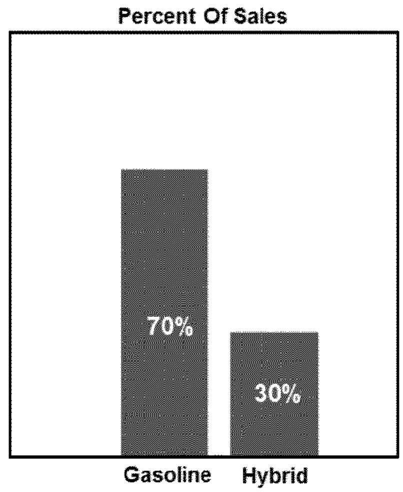


Figure E-22: 2016 Lincoln MKZ Gasoline and Hybrid Customer Take Rates[289]

For the majority of PHEV, HEV, BEV, and fuel cell vehicle offerings in 2015, affordable pricing has not stimulated shopping. Of the EV Market, 81% is represen ted by non-luxury vehicles, according to IHS Markit.[290] Figure E-23 outlines the segmentation of the full EV market. More than 50% of the EV market is non-luxury compact cars that, afte r incentives, are generally near the entry-level price points in the new vehicle market.[291] Low familiarity with new technology, concerns on range, and lifestyle compromises (size, payload and towing capability, etc.) appear to continue to obstruct customer willingness to embrace technology for the price.

[289] Courtesy of Ford Motor Company.
[290] IHS Markit - Used with permission of IHS Markit
[291] *Id.*

Segment Share of EV Registrations

Non-Luxury Segmentation: 15CY		Luxury Segmentation: 15CY	
COMPACT CAR	51.6%	SUB COMPACT CAR	5.7%
MID SIZE CAR	21.7%	FULL SIZE CAR	5.4%
SUB COMPACT CAR	2.9%	MID SIZE CAR	2.4%
FULL SIZE CAR	2.5%	COMPACT CAR	2.2%
COMPACT CUV	1.6%	MID SIZE CUV	2.1%
MID SIZE CUV	0.8%	COMPACT CUV	0.5%
COMMERCIAL TRUCK	0.1%	SPORT	0.4%
MID SIZE SUV	0.1%	EXOTIC	0.1%
FULL SIZE SUV	0.0%	FULL SIZE SUV	0.0%
FULL SIZE 1/2 TON PICKUP	0.0%	**Luxury Total**	**18.8%**
COMPACT VAN	0.0%		
Non-Luxury Total	**81.2%**		

Segment share of EV registrations based on on IHS Markit total U.S. new light vehicle registrations (cars and trucks) for 2015 BEVs, PHEVs, Fuel Cell Vehicles and HEVs.

Figure E-23: Industry Electric Vehicle Segmentation, 2015 Calendar Year (Luxury/Non-Luxury)[292]

To date, many EVs considered as "luxury" have prioritized high performance, such as the Tesla Model S which can reach 0-60mph in as little as 2.5 seconds.[293] The luxury EV segment (representing 19% share of EV registrations in 2015[294]) has seen recent growth. Where luxury or high performance EVs can offer radically new technology or record setting performance, certain customers can be drawn to this segment and are willing to pay a premium to be part of a technological advance. A study from King Abdullah Petroleum Studies and Research Center (KAPSARC) found that affluent BEV adopters value powertrain performance, availability of rear-wheel drive, seating, and cargo capacity more than other BEV buyers.[295] As demonstrated by the KAPSARC results, luxury EV segment customers desire performance more than non-luxury EV buyers and are willing and able to spend on EV technology.

Tax Incentives for Electric Vehicles

Plug-in electric vehicle sales have been supported by federal tax incentives whose amounts are determined by battery capacity, along with additional incentives and rebates in some states and local districts. The incentives generally support both vehicle purchases and leases and are combined with manufacturer rebates and incentives. Federal incentives are scheduled to phase out after a manufacturer sells 200,000 qualifying vehicles.

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[292] *Id.*
[293] Tesla Model S. Tesla. Accessed September 26, 2016. https://www.tesla.com/models.
[294] IHS Markit. Used with permission of IHS Markit
[295] Dua, et al. "Understanding Adoption of Energy-Efficient Technologies: A Case Study of BEV Adoption in the U.S." 2016. KAPSARC. 35.

Stimulating customers towards lower priced, non-premium EV vehicles with government subsidies appears logical, however the nuances of present incentive structures favor vehicles with larger battery packs which likewise mean higher prices. Mass adoption is not promoted because customer preferences are not aligned. Furthermore, the federal incentives are volume-limited and do not support long-term compliance with the standards. Government incentives have supported deployment of electric vehicles to early adopters to achieve the limited market share seen to date, but are not expected to be available to support mass-market growth.

Third-Party Reviews of Electrified Vehicles

Third-party automotive website reviews attempt to make the car buying process simple through fair product assessment and education for customers prior to their purchase decision. Simple site navigation and increased use of the visual web are strengths, however in assessing the usefulness of these sites during the shopping process, J.D. Power identifies a gap in satisfaction between third-parties and the manufacturers. [296] Key findings state that an expert review must cover the basics with priority on safety, performance, and functionality. While using J.D. Power's criteria for automotive third-party sites pertaining to the basics of EVs, safety and functionality are not primary variables.

As noted in Kelley Blue Book's Best Green Cars, [297] the basis of their ranking was most efficient vehicles across all price ranges and powertrain variabilities. The lack of the total ownership and value for the money propositions kept "green" vehicle intenders misinformed of safety and functionality.

Autotrader's "8 Least Expensive Electric Vehicles" report from January 2015[298] lists the cheapest BEV/PHEV and range, but did not educate customers on safety features, powertrain performance, functionality, or reality of real-world acceptance.

Overall, for self-motivated EV buyers, the most important research content can be found on the manufacturers' sites. Auto reviews simply provide validation of products dependent on their criteria as Best or Top Picks without applying the non-premium customer product attribute priorities such as value for the money.

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[296] "2016 Third-Party Automotive Website Evaluation Study: Visual Web, Minimalist Navigation Tools Drive Increases in Shopper Satisfaction." J.D. Power. March 24, 2016. Accessed August 31, 2016. http://www.jdpower.com/cars/articles/jd-power-studies/2016-third-party-automotive-website-evaluation-study-visual-web.

[297] "10 Best Green Cars Of 2015 Named By Kelley Blue Book," Kelley Blue Blook. April 16, 2015. Accessed August 31, 2016. http://mediaroom.kbb.com/2015-04-16-10-Best-Green-Cars-Of-2015-Named-By-Kelley-Blue-Book.

[298] "8 Least Expensive Electric Vehicles," *AutoTrader*. January 2015. Accessed August 31, 2016. http://www.autotrader.com/best-cars/8-least-expensive-electric-vehicles-234077.

Expanded Choice and Competition in EV Market

The EV marketplace (hybrid, plug-in hybrid, and battery electric vehicles) is rapidly changing and growing with 46 models of hybrids, 18 battery electric models, and 12 plug-in hybrids offered in MY2015.[299]

Moreover, PEVs are offered in a variety of vehicle categories as shown in Table E-1 below.

EPA Vehicle Category	Number of Models
Mini-compact Car	1
Two-Seater	1
Subcompact Car	7
Compact Car	5
Midsize Car	6
Large Car	3
Small Station Wagon	1
Small SUV	1
Standard SUV AWD	5
Mini-Van (end of CY2016)	1

Table E-1: EPA Categories for Plug-In Electric Vehicles

The growth of EV product entries will address the issue of product variety and choice to the mainstream buying audience. However, the relatively stagnant sales rates, combined with new entries, will lead to fierce competition within the already small marketplace.

In some states, the cost of leasing some EVs is actually negative. For example, as shown in Figure E-24 below, a recent review of on-line advertised leasing rates combined with federal, state and local incentives show that low-income customers in the San Joaquin Valley can make money if they lease a Chevrolet Spark, Volkswagen e-Golf, Fiat 500e, Smart fortwo, Kia Soul EV, or Nissan LEAF.

[299] www.FuelEconomy.gov

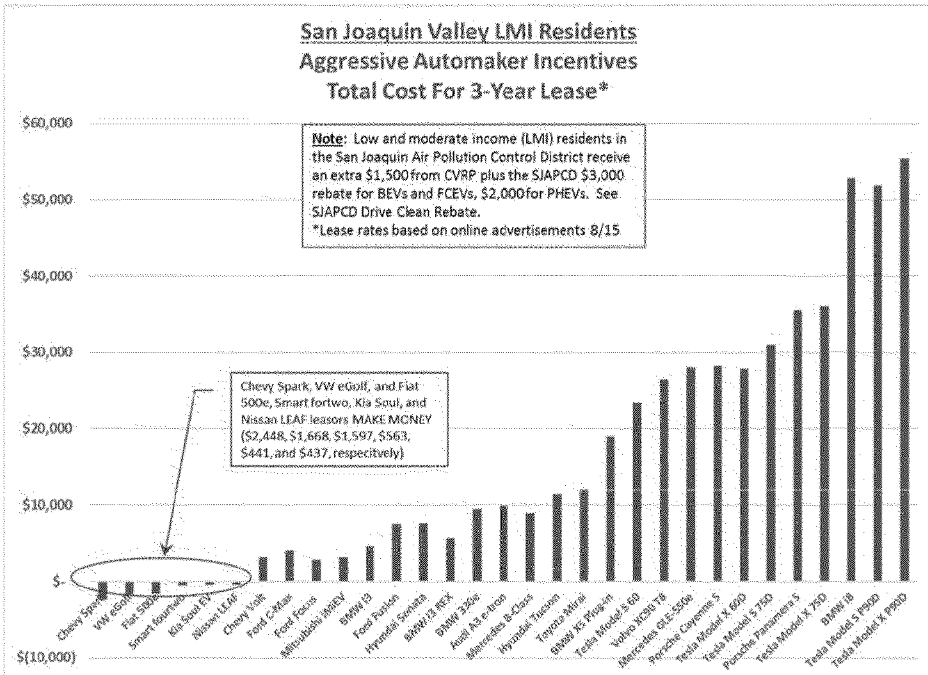

Figure E-24: Total Cost of 3-Year Lease for Low Income San Joaquin Valley Residents300

The extraordinary OEM incentives and extended financing solutions used to persuade customers with a manageable average transaction price/monthly carry-cost will be further stressed by increasing technology costs particularly on the non-premium EV vehicles which represent a majority of the marketplace.

Insurance Rates

In June of 2014, NHTSA published a comparison of differences in insurance costs for vehicles on the basis of damage susceptibility; dealerships were required to place copies of this guide in showrooms for prospective vehicle purchasers.[301] The report presents vehicles' collision loss data compiled by the Highway Loss Data Institute for MY2011-2013.[302] The report presents this loss experience in relative terms, with "100" representing the average damage payment for all passenger vehicles, where a rating over 100 is worse than average, while a score of less than 100 is better than average. The guide presents data on hundreds of vehicles and includes 22 HEV, PHEV, and BEV models. For this sample of vehicles with electrification, only two had scores of

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[300] Based on research of internet advertised leased deals as of August 15, 2016. Calculated total cost equals monthly lease rate multiplied by lease term, plus down payment, less California Clean Vehicle Rebate amount, low income California Clean Vehicle Rebate, and San Joaquin Valley Drive Clean Rebate.
[301] "Comparison of Differences in Insurance Costs for Passenger Cars, Station Wagons, Passenger Vans, Pickups, and Utility Vehicles on the Basis of Damage Susceptibility." National Highway Traffic Safety Administration. June 2014. Accessed September 26, 2016. http://www.nhtsa.gov/theft.
[302] *Id.*

less than 100, and in total ranged from 91-236 with the average of the 22 vehicles at 127. This indicates that it is not unthinkable that, by adding additional technologies, the price to repair vehicles will increase. The Agencies should study the possible impacts of higher insurance prices on the uptake of such vehicles today, and on the costs to customers of additional technology as the standards increase in stringency through 2025. This higher cost is only further compounded by the extended financing terms likely to result from higher vehicle prices as customers must retain full insurance coverage on vehicles throughout the entire loan period.

Gasoline Price Estimates

Gasoline prices are a key component of any estimates for vehicle sales. Customer payback is tied to gasoline prices, and customer payback, along with the discount rate used by customers, enables a projection of future sales levels to be made. The Agencies rely on AEO2015 for the gasoline price projections in the Draft TAR. In several places, the Agenciespoint out the inability of AEO2011 to correctly anticipate the great decrease in gasoline prices in the 2014-2016 time period.[303] AEO2015 and AEO2016 incorporate the lower gasoline prices but project, as did AEO2011, that gasoline prices will immediately rebound and then resume to increase.

The Alliance associates the drop in gasoline prices with the advent of fracking in the oil well industry.[304] Fracking has resulted in the ability to produce more oil at lower cost from existing oil wells. And at the same time that fracking is applied to more and more wells, the science and methods of fracking continue to be developed. Horizontal fracking and other advances will continue to allow more and more oil to be pumped.[305] This leads us to suggest that the automatic rebound built into AEO2015 and AEO2016 may be premature and too great in size to represent a likely gasoline price scenario. NHTSA, in fact, anticipates the likelihood of such a scenario by including a Volpe low case fuel price for its CAFE modeling.[306] This is shown in the following Figure E-25:

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303 Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 3-5, 13-80, 13-81, Figures 3.3, 13.13, 13.14.

304 "Energy chart of the day: America's shale oil revolution will reverse a 40-year decline in crude oil output in just 5.5 years" U.S. Energy Information Administration. May 6, 2014. http://www.aei.org/publication/energy-chart-of-the-day-americas-shale-oil-revolution-will-reverse-a-40-year-decline-in-crude-oil-output-in-just-5-5-years/.

305 Big Data Will Keep the Shale Boom Rolling. MIT Technology Review. June 2, 2015. https://www.technologyreview.com/s/537876/big-data-will-keep-the-shale-boom-rolling/.

306 Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 13-90.

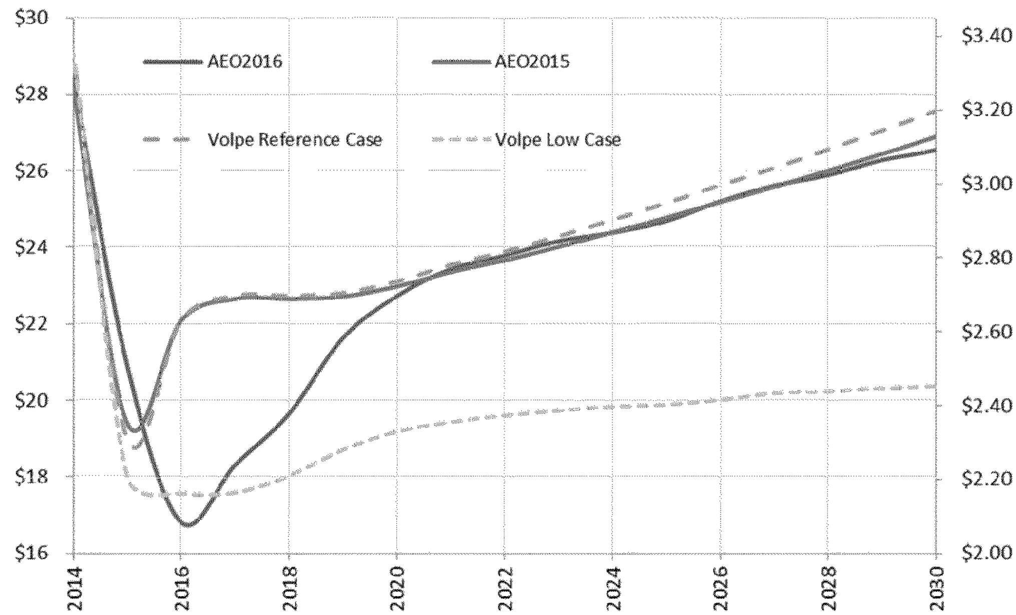

Figure E-25: Various Fuel Price Cases

We urge both Agencies to consid er using the less rebounding, lo wer sloped Volpe Low Case gasoline scenario, for use in the modeling and sensitivity analyses in the next step of the MTE.

Impacts if Customers Are Unwilling to Pay

Decrease in New Vehicle Sales

EPA does not provide a quantitative estimate of the impact of the standard on overall employment because it claims it cannot estimate the output effe ct (i.e., the effect due to changes in vehicle sales only). The EPA analysis of employment effects is limited to partial assessment of substitution effects, which is insufficient to guide policy mak ing.[307] We discuss the Agencies' shortcomings in estimating vehicle sales above in the section t itled "Estimating the Impact of Higher Standards on Sales" and the effect of lower sales on employment in Appendix F: Employment Impacts.

Decreased Fleet Fuel Savings and CO2 Reductions

Additional impacts from customers purchasing fewer new vehicles include reduced turnover of the vehicle fleet, leading to longer retention of older, less efficient vehicles. If sales of highly efficient new vehicles are reduced, overall fleet fuel savings and CO_2 reductions will not be realized at the same rate. As is discussed above, the Agencies should estimate the impact of the

[307] *Id.* at 7-12.

standards on sales and compare fuel and CO_2 savings under the industry sales level associated with the reference MY2022-2025s scenario and savings under the industry sales associated with the MY2022-2025 standards.

Impacts on Used Vehicle Market and Access to Mobility

Experts have noted that used vehicle prices move in lockstep with new vehicle prices.[308]

As new vehicle prices increase due to the added cost of technology to comply with the GHG standards, the cost of used vehicles will increase with attendant effects on lower-income households. We therefore do not agree with Figure 6.1 in the Draft TAR which suggests that used-car prices will continue to decline. In fact, if over the long-term, new vehicle sales decrease, the supply of used vehicles is likely to remain flat or decrease, further placing upward pressure on the prices of used cars. Although customers may hold their vehicles for longer time periods, potentially increasing the average vehicle lifetime, fewer replacement vehicles would enter the used market. At the same time, if customers are pushed out of the new vehicle market into the used market, demand for used vehicles would increase, driving up prices.

Given these converging market forces, it is not clear to the Alliance how the Draft TAR can make a suggestion that used car prices will decline.

The Alliance commissioned a review of academic literature that sheds light on the impacts of the fuel economy standards on lower-income households. [309] This study finds that fuel economy standards have a disproportionate impact on low income households.

> Although it is generally believed that more stringent fuel economy standards and the accompanying increase in vehicle price and other ownership costs largely impacts only high income households, recently published, peer-reviewed research contradicts this conventional wisdom. University of California at San Diego Economics Professor Mark Jacobsen finds that fuel economy standards impose costs whose effects are 'sharply regressive,' requiring the poorest 25% of the population to incur [additional] ongoing/annual costs amounting to nearly three times the fraction of their incomes that the richest 25% have to pay.[310]

[308] "Waiting for used-vehicle prices to fall? Not yet." Automotive News. September 8, 2016. Accessed September 26, 2016. http://www.autonews.com/article/20160908/RETAIL04/160909849/waiting-for-used-vehicle-prices-to-fall-not-yet.
[309] T. Walton, Defour Group. "The Impact of Future Fuel Economy Standards on Low Income Households." September 2, 2016. Attached as Attachment 11.
[310] *Id.* at 6.

Customers would be impacted by rising prices in the used vehicle market including reduced access to newer or more capable vehicles. The Agencies should study the impact of a decrease in industry sales on used vehicle pricing.

Recommendations

In addition to the customer acceptance issues described above, which the Alliance recommends the Agencies consider during the remainder of the MTE process, the Alliance has some additional specific recommendations to improve the Agencies' treatment of customer acceptance issues, discussed below.

Complementary measures to help drive customers to making the "right" decision

The Agencies should pursue measures to better align incentives in the marketplace with fuel efficient technologies. As discussed above, customers do not value fuel economy beyond limited payback periods, limiting the additional upfront investments they are willing to make to purchase fuel efficient vehicles and technologies. Incentives and other policies that reduce customer payback periods or lower the bar for investment in advanced technology vehicles are needed to expand customer adoption of these technologies. The Agencies should identify policy options for Congress, states, and other agencies to consider that would encourage customers to purchase fuel efficient vehicles, such as continued or expanded incentives for fuel efficient and alternative fuel vehicles.

Research NVES data to get better understanding of customer choices/decisions

Strategic Vision's New Vehicle Experience Study (NVES)[311] is a robust survey of new vehicle buyers, which provides insight into how customers make new vehicle purchasing decisions. The survey data can be mined and trended to infer, among other things:

- How new vehicle buyers rank fuel economy against other vehicle attributes
- What vehicle lines and segments customers choose when gasoline prices are high, or low
- What vehicle lines and/or segments customers buy given demographic and income characteristics
- Vehicle payment method, vehicle replaced, and future vehicle considerations

Access to similar data should give EPA insight into which types of customers are more likely to exit the pool of new vehicle buyers, or become unable to afford certain vehicle segments as new vehicle prices rise due to fuel economy requirements. Furthermore, this survey data would give EPA insight into customers' willingness to pay for fuel economy and/or willingness to compromise on vehicle choice. Finally, this data provides fresh evidence of how customers

[311] "NVES." Strategic Vision. Accessed September 6, 2016. http://www.strategicvision.com/#!nves/fchi4.

behaved during two critical periods in the automotive industry, including the 2008-2009 recession, which reflected a period of high gasoline prices, as well as the most recent 2014-2015 period of low gasoline prices. The latter period, with gasoline prices below $3/gallon, has added further downward pressure on smaller car segments and electric vehicle demand as customer favor larger segments and CUV/SUV mixes.

Appendix F: Economic Assessment: Employment Impacts

As discussed in Appendix E of these comments, the Agencies have an obligation to consider economic factors. This Appendix will focus on one economic item in particular—employment impacts.

The greater automobile industry is a massive employer reaching well beyond the auto manufacturers. Auto manufacturing depends on a broad range of parts, components, and materials provided by thousands of suppliers, as well as a vast retail and vehicle maintenance network of dealers. Nationwide, eight million workers and their families depend on autos. Each year, the industry generates $500 billion in paychecks, while generating $70 billion in tax revenues across the country.[312] An accurate and thorough evaluation of employment impacts is critical for both the success the ONP and the continued health of the U.S. economy. Therefore, the Alliance encourages the Agencies to fully consider a peer-reviewed study that is taking place at the Indiana University School of Public and Affairs (IU) (IU Policy Paper).[313]

In February 2016, the IU Policy Paper summarized the results of several recent employment studies that should have been considered in the Draft TAR.[314] The IU Policy Paper reviewed and identified limitations in some previous industrial impact studies. These limitations included the failure to consider the ZEV Program in conjunction with the federal standards; differing assumptions about the "green jobs" impact of regulation; the failure to understand state and regional impacts; and the failure to consider recent changes in global oil prices. The IU Policy Paper concludes that "methodological improvements are possible for new regulatory analyses in order to provide a more accurate and complete understanding of the macroeconomic effects of the federal and ZEV regulatory programs."[315] The study team made several preliminary recommendations for the MTE; it will issue a final report with quantitative analysis in January 2017. That analysis should inform the MTE.

The Agencies Acknowledge Their Responsibility to Estimate Employment Impacts

In determining appropriate changes to CAFE standards, and in determining appropriate levels for GHG standards, the Agencies are required to consider the impacts of the standards on employment and adjust the standards accordingly.

[312] "Contribution of the Automotive Industry to the Economies of All Fifty States and the United States." Center for Automotive Research. 2015.
[313] Carley, *et al.* "Rethinking Auto Fuel-Economy Policy: Technical and Policy Suggestions for the 2016-2017 Midterm Reviews, Phase 1 Report." (Feb. 2016).
[314] *Id.*
[315] *Id.* at 42.

In acknowledging the need to consider employment impacts, the Draft TAR references the Presidential Memorandum that requires the Agencies to consider employment impacts when establishing the National Program. In acknowledging the need to consider employment impacts, the Draft TAR references the Presidential Memorandum that requires the Agencies to consider employment impacts when establishing the National Program. The Presidential Memorandum requested that Agencies develop the ONP to "strengthen the [auto] industry and enhance job creation in the United States." [316], states that, "Our regulatory system must protect public health, welfare, safety, and our environment while promoting economic growth, innovation, competitiveness, and job creation."[317] Acknowledging these goals, the 2012 FRM lists "[i]mpacts on employment, including the auto sector" as one of the factors to be considered in this Draft TAR."[318]

In addition to these statutory and regulatory imperatives, Executive Orders 13563 and 12866 require Agencies to provide a RIA for economically significant regulatory actions. While the Alliance understands that the Draft TAR is not the formal RIA that will be required before the Agencies take final action on the MY2022-2025 rules, the Draft TAR sets the table for the upcoming NPRM and accompanying RIA, and should therefore follow the same principles of regulatory cost-benefit analysis.

OMB Circular A-4 [319] outlines the steps for an RIA. These include selecting a baseline that "represents the Agency's best assessment of what the world would be like absent the action" [320] and "using the best reasonably obtainable scientific, technical, economic, and other information to quantify the likely benefits and costs of each regulatory alternative."[321]

The Draft TAR Fails to Estimate Employment Impacts

The Draft TAR attributes possible employment effects to two factors: increases or decreases in vehicle sales (termed "output effects') and increased spending by automakers and suppliers to design, manufacture and install the technologies needed to meet the standards (termed "substitution effects"). Neither Chapter 7 (Employment Impacts) nor Chapter 13 (Analysis of Augural CAFE Standards) quantify sales changes due to the standards or employment changes in the automotive industry. Instead, the Draft TAR presents qualitative assumptions about how customer behavior may impact sales.

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[316] Executive Order 13563 , "Improving Regulation and Regulatory Review" (January 18, 2011)
[317] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 7-1.
[318] 77 Fed. Reg. 62784 (Oct 15, 2012).
[319] Circular A-4. White House Office of Management and Budget. Accessed September 26, 2016. https://www.whitehouse.gov/sites/default/files/omb/assets/regulatory_matters_pdf/a-4.pdf.
[320] *Id.* at 4.
[321] *Id.* at 9.

The Draft TAR summarizes the Agencies' overall view of employment impacts by stating that in a full employment scenario, employment losses do not matter:

> In an economy with full employment, the primary employment effect of a rulemaking is likely to be to shift employment from one sector to another, rather than to increase or decrease employment…under conditions of full employment, any changes in employment levels in the regulated sector due to this program are mostly expected to be offset by changes in employment in other sectors.[322]

This approach, unfortunately, is similar to the approach taken in the 2012 FRM establishing the MY2017-2025 standards. At that time, the Agencies found sales "very difficult to predict," and concluded that because "sales have the largest potential effect on employment, the impact of this final rule on employment is also very difficult to predict."[323]

There is ample precedent, however, for the Agencies to consider impacts to employment and to make appropriate modifications to standards. In the past, NHTSA has considered impacts on employment due to proposed standards and has modified the standards to those impacts into account. Specifically, a thorough consideration of economic impacts was done in the analyses for the 1986 CAFE rules for cars and in the 1990 CAFE rules for trucks when the CAFE requirements were relaxed.[324] By not providing quantitative estimates of the output effect and only a partial estimate of the substitution effect, the Agencies cannot reach a quantitative estimate of the overall employment effects of the final rules on motor vehicle sector employment or even whether the total effect will be positive or negative.

A recently released report, CAR report provides an estimate of employment impacts due to the CAFE and GHG standards.[325] The report first performs a broad review of previous academic studies and published literature on short-term and long-term price elasticities. Based on this review, the average long-run, own price elasticity for new vehicle sales revenue is estimated to be an average -0.61. Using this -0.61 elasticity value, Table 8 of the CAR study summarizes the results of nine potential scenarios in 2025, using $2,000, $4,000 and $6,000 vehicle price increases, and scenarios of $2.44, $3.00 and $4.64 per gallon gasoline prices.[326] For eight of the scenarios, vehicle demand is projected to decrease due to the higher vehicle prices, ranging from 370,000 to 3.7 million fewer sales. In only one scenario, where gasoline prices are projected to

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[322] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 7-13 et seq.
[323] 77 Fed. Reg. 62623, 63112 (Oct. 15, 2012).
[324] 51 FR 35594 (October 6, 1986) and 53 FR 33080 (August 29, 1988)
[325] "The Potential Effects of the 2017-2025 EPA/NHTSA GHG/Fuel Economy Mandates on the U.S. Economy, September 2016." Center for Automotive Research. 2016.
[326] *Id.* at 42.

be high ($4.64 per gallon) and where vehicle technology costs are projected to be low ($2,000), is there a projected increase in sales (of 410,000 vehicles).

The CAR study estimates job losses from the projected sales decrease scenarios as 0.1 million (lowest sales decrease scenario) to 1.1 million jobs (highest sales decrease scenario) in the overall U.S. economy.[327]

Employment Changes Due to Substitution Effects Are Likely Overstated

The Draft TAR discusses possible employment effects based on two factors: effects on employment due to increases or decreases in vehicle sales (termed "output effects") and effects on employment due to increased spending by automakers and suppliers to design, manufacture, and install the FE technologies (termed "substitution effects") . Draft TAR, Chapter 7 begins the discussion of substitution effects, or the effects using estimates of the historic share of labor as a part of the cost of production. These historic shares of labor are extrapolated based on the increased cost of production, *i.e.,* X increase in cost of production is extrapolated to Y increased cost of labor, which is then made equivalent to Z change in labor headcount. The Agencies state that this will only "provide a sense of the order of magnitude of expected impacts on employment…"[328] Nevertheless, the Agencies extrapolate the potential increased employment based on Table 7.2, which shows an extrapolation from $14.7 billion in increased compliance costs to a range of 1,200 to 11,800 added workers in 2025.

This extrapolation is based on a historic share of labor from the Bureau of Labor Statistics Employement Requirement Matrix data in combination with the Annual Survey of Manufacturers and Economic Census data and then (likely) adjusted for productivity improvements based on historical trends of a 6.6% per year productivity improvement in the Motor Vehicle Manufacturing Sector, and a 4.9% per year improvement in the Motor Vehicle Parts Manufacturing Sector.[329]

Even though this extrapolation accounts for historically accurate trends in the productivity increases, it does not likely capture historic secular trends that are occurring in the automotive industry, largely as a result of the extreme fuel economy increases required by the rules. In the 2012 FRM, the EPA titled such changes "factor shift effect,"[330] but in the end determined not to modify historic shares of labor based on trends. Factor shift effects are shifts in the historic ratio of labor-to-part cost. It is clear that some technologies will require significantly less labor than

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[327] *Id.* at 49.
[328] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 7-8.
[329] *Id.* at 7-9.
[330] 77 Fed.Reg. at 62956.

other equivalently effective technologies, and it is also clear that some of those types of technologies will be relied upon much more in the future. Thus, the Agencies should address (in the next step of the MTE) factor shift effects due to reasonably anticipated declines in labor content of certain technologies, by, as an example, extrapolating and comparing the direct labor costs from the FEV teardown studies performed for fuel economy technologies considered in the 2012 FRM.

For instance, the reasonably anticipated increase in the number of electrified platforms needed to achieve the 2025 standards will significantly deviate from the historic ratio of labor-to-part cost in several ways. Electrified platforms will use large, consolidated assemblies, such as EV/HEV/PHEV battery packs and electric motors, which could achieve a large FE increase with a lower increase in labor cost, as compared to, for instance, incremental approaches to improving powertrain efficiency. It is clear that labor is a small share of the cost of a battery as shown in Figure F-1.

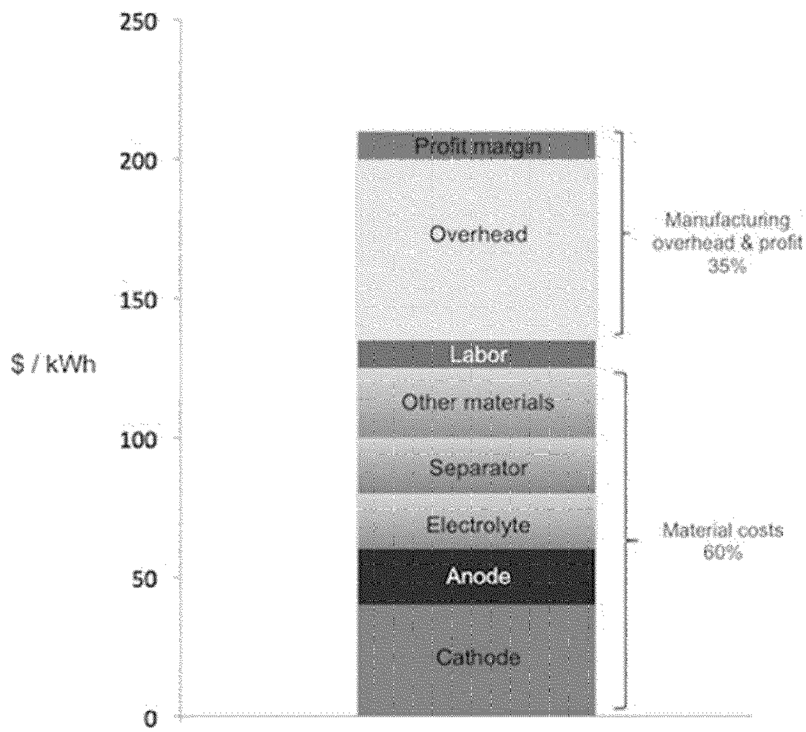

Figure F-1: Breakdown in Battery Cost Contributors[331]

[331] The Cost Components of a Lithium Ion Battery. Qnovo. Accessed September 26, 2016. http://qnovo.com/82-the-cost-components-of-a-battery/.

In addition to the reduced labor content of the large consolidated parts used in EVs, Tesla is planning to pioneer an assembly line for production of the Model 3 that eliminates all labor for EV assembly.[332] You really can't have people in the production line itself,' said Musk."[333]

Already Tesla's changes to the way vehicles are sold and distributed are heralding a reduction in the labor content at dealerships necessary to sell and service EVs.[334] A dealership in Ohio, notes that "[i]f other carmakers followed Tesla, essentially, it would put us out of business."[335] The Agencies can reasonably conclude that significant declines in labor content are possible with the introduction of EVs and should account for these decreases in the NPRM.

Employment Changes Due to Fuel Savings Being Spent in the General Economy Are Likely Overstated

In the 2012 FRM, the Agencies declined to quantify multiplier effects (e.g.,customers spending their fuel savings in the general economy and thereby increasing employment in the general sector) stating, "[w]e do not quantify multiplier effects, due to uncertainty over the state of the economy at the time this rule takes effect as well as the market evolutions that are likely to occur between now and implementation."[336]

The Draft TAR notes that "consumer spending is expected to affect employment through changes in expenditures in general retail sectors; net fuel savings by consumers are expected to increase demand (and therefore employment) in other sectors"[337] but does not attempt to further quantify that effect.

The Draft TAR pre-qualifies the amount of the stimulus that would be available by stating, "[a]s a result, consumers are expected to have additional money to spend on other goods and services, though the timing for access to that additional money depends on the payback period..."[338]

This means that employment stimulus due to fuel savings must wait until payback is achieved. However, due to low gasoline prices and high vehicle compliance costs, using EPA's payback calculations in Table 12-52, payback is only achieved (using EPA's compliance cost estimates)

[332] Elon Musk: Tesla's Model 3 factory could look like an alien warship. The Washington Post. Accessed September 26, 2016. https://www.washingtonpost.com/news/the-switch/wp/2016/08/04/the-future-of-car-production-will-be-devoid-of-people-according-to-tesla/.
[333] *Id.*
[334] The battle between Tesla and your neighborhood car dealership. The Washington Post. Accesed September 26, 2016. https://www.washingtonpost.com/business/economy/the-battle-between-tesla-and-your-neighborhood-car-dealership/2016/09/09/55fb1878-6864-11e6-99bf-f0cf3a6449a6_story.html.
[335] *Id.*
[336] 77 Fed. Reg. at 62953 (October 15, 2012).
[337] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 7-14.
[338] *Id.* at 7-13.

after five years of ownership.[339] This means, of course, that any employment stimulus due to fuel savings must wait five years.

This is also assuming that the vehicle is purchased in the first place, a questionable assumption in light of evidence that customers only consider the first three years of fuel savings in any prospective purchase payback calculation.[340]

[339] *Id.* at 12-43.
[340] "Cost, Effectiveness and Deployment of Fuel Economy Technologies for Light-Duty Vehicles." National Academy of Sciences, National Research Council to the National Academies. 2015. 317.

Appendix G: Regulatory Elements Necessary for Compliance

Mobile Air Conditioning (MAC)

The Alliance believes that MAC improvements will continue to contribute to lower greenhouse gas emissions and reduced fuel consumption. To better realize MAC improvements, the Alliance proposes the following recommendations regarding the system of MAC credits including:

- EPA should consider adjusting MAC credits upward to reflect more accurate information on actual air conditioner usage.
- EPA should consider simplifying and standardizing the procedures for claiming off-cycle credits for the new MAC technologies that have been developed since the creation of the MAC indirect credit menu.
- EPA should consider simplifying and streamlining its review and approval processes to create new credits for additional technologies under the off-cycle credit provisions, without maintaining prohibitive testing burdens for every case-by-case credit application.
- The EPA should consider removing the cap on low-leak credits, since it limits the incentive to achieve the maximum achievable emission reductions in this area.
- EPA should consider eliminating the penalty of up to two grams CO_2 per mile for systems that use R-1234yf (or other low-global warming potential (GWP) refrigerants) but fails to achieve certain low-leak levels.

These issues are explained in further detail below.

MAC Efficiency

In the 2012-2016 light-duty GHG and CAFE regulation (2010 FRM) [341] EPA created a list of efficiency technologies which could earn a pre-defined and pre-approved credit in grams per mile of CO_2.[342] These were termed "indirect" MAC credits, since the emissions reduction did not result within the air conditioner system itself, but rather from the savings in fuel ultimately used to power the MAC system. The baseline for these credits is EPA's estimate of the total fuel usage (and hence indirect emissions) from light-duty mobile air conditioner usage in the U.S., which EPA estimated to be 14.3 grams CO_2 per mile, or 3.9% of total national light-duty vehicle fuel usage.

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[341] "Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards; Final Rule". 75 Fed. Reg. 25324 (May 7, 2010).
[342] Id. at 25428.

The technologies identified for pre-approved credits and the percentage efficiency improvement estimates for these technologies came primarily from the Improved Mobile Air Conditioner (IMAC) industry-government Cooperative Research Program conducted through SAE International. IMAC was a partnership between EPA, DOE and 28 corporate sponsors, which published its final report in 2006. [343] The IMAC program demonstrated an improvement of 36.4% in MAC efficiency using best-of-the best designs for these technologies on a test vehicle, compared to a baseline MAC system using a defined list of typical technologies in production at that time, such as a fixed displacement compressor. [344] Based primarily on the IMAC report, EPA estimated that a 40% MAC indirect emissions reduction was possible using the technologies on the pre-approved list, and set a cap on these credits based on a 40% improvement level, equating to a cap of 5.7 grams CO_2 per mile.[345]

The pre-defined and pre-approved MAC indirect credit menu has proven to be a highly successful approach for gaining rapid implementation of air conditioner efficiency technologies. Air conditioner efficiency technologies were not heavily used among vehicles sold in the U.S. at the beginning of the greenhouse gas regulatory period, with the total industry claiming only an average of 1.0 gCO_2/mile in CO_2 credits in 2009. Since then, manufacturers have claimed credits significantly faster than assumed by EPA when the Agency drafted the 2012-2016 standards, rising to an average industry credit of approximately 3.4 gCO_2/mile in 2014. This is 60% of reaching the maximum capped credit level of 5.7 gCO_2/mile. MAC indirect credits are playing a critical role in industry compliance with the light-duty vehicle GHG regulation, achieving emission reductions that would not otherwise have been possible using the previous CAFE regulatory framework.

EPA has acknowledged the importance MAC credits as a significant source of real-world benefits:

> About 40 percent of these [credits] were accrued through the use of the optional credit programs for air conditioning systems, indicating a significant, real-world benefit as a result of the introduction of the technologies underlying these optional credit programs.[346]

The Draft TAR states:

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[343] SAE International. Refrigerant Leakage Reduction. IMAC Team 1 Final Report. 2007.

[344] "Final Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, Regulatory Impact Analysis." U.S. Environmental Protection Agency. EPA-420-R-10-009. April 2010. 2-30.

[345] This cap was subsequently modified by the MY2017-2025 rulemaking to 5.0 grams CO_2 per mile for cars and 7.2 grams CO_2 per mile for light trucks, starting with MY2017 to more accurately align the improvements based on the physics of the vehicles.

[346] "Greenhouse Gas Emission Standards for Light-Duty Vehicles: Manufacturer Performance Report for the 2012 Model Year." U.S. Environmental Protection Agency. 2014. 11.

> Many manufacturers have taken advantage of the A/C credit program to generate and bank A/C efficiency credits, which have become an important contributor to industry compliance plans. As summarized in the EPA Manufacturer Performance Report for the 2014 model year, 17 auto manufacturers included A/C efficiency credits as part of their compliance demonstration in the 2014 model year. These amounted to more than 10 million Mg of credits, or about 25 percent of the total net credits reported. This is equivalent to about 3 gCO_2/mile across the 2014 fleet.[347]

Looking forward, the Draft TAR also states:

> Additional information that has become available, as well as changes in the overall regulatory environment affecting the A/C technology developments in the light-duty vehicle industry, reinforces our earlier conclusions that these technologies will continue to expand and play an increasing role in overall vehicle GHG reductions and regulatory compliance.[348]

EPA based its MAC efficiency credits on estimates of each technology's percentage impact on the total fuel usage by vehicle air conditioner systems in the U.S. However, EPA's estimate of baseline air conditioner energy usage (3.9% of total light-duty fuel consumption) was well below the estimates of others, such as researchers from the National Renewable Energy Laboratory (over 6%) and Oak Ridge National Laboratory, as well as longstanding benchmarks used by industry. The Alliance continues to believe that this low baseline used by EPA, which was approximately half the baseline MAC energy usage estimated by the other major sources, resulted in MAC efficiency credits and an associated credit cap which are far below the actual real-world fuel savings and CO_2 reductions that are resulting from these technologies. At a minimum, the existing MAC indirect credit system cannot be viewed as excessive or overly generous. Instead, as a result of the EPA methodology, these credit amounts were set at very conservative levels.

Since the 2007 publication of the IMAC final report and 2010 FRM[349] (with its indirect MAC credit menu), additional MAC technological progress has occurred. Automobile manufacturers hope to expand on the success of the MAC indirect credit menu by earning credits for these more recent technological developments, thereby accelerating the adoption of the new technologies. The off-cycle greenhouse gas credit provisions provide a means to do this since additional MAC

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[347] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 5-210.
[348] *Id.* at 5-208.
[349] "Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards; Final Rule". 75 Federal Register 25324 (May 7, 2010).

efficiency technologies are listed as eligible for credits under the off-cycle provisions. Automakers request that EPA simplify and standardize the procedures for claiming off-cycle credits for the new MAC technologies that have been developed since the creation of the MAC indirect credit menu. The variable crankcase suction valve technology provides a case study for potential improvements.

Variable CS Valve Compressor

The variable crankcase suction valve for MAC compressors provides an example of the potential for additional emissions reductions in this area and the regulatory improvements that can be made to help achieve these reductions. On September 1, 2015, General Motors was granted 1.1 grams CO_2 per mile per vehicle in off-cycle credits for its use of an improved air conditioner compressor with variable crankcase suction valve technology.[350] The Denso SAS compressor is a new Externally-controlled Variable Displacement Compressor (EVDC) design that improves the internal valve system within the compressor to reduce the internal refrigerant flow necessary throughout the range of displacements that the compressor may use during its operating cycle. This is achieved though the addition of a variable crankcase suction valve (variable CS valve). Conventional compressors have a fixed crankcase to suction bleed that regulates the flow of refrigerant exiting the crankcase. The sizing of the bleed is a compromise among the conditions when either a high rate of flow or a low rate of flow would be more ideal. In conditions where maximum air conditioner capacity is not needed, this fixed bleed creates an unnecessary reduction of volumetric efficiency for the compressor. In contrast, a variable CS valve can provide a larger mass flow under maximum capacity and compressor start-up conditions, when high flow is ideal; it can then reduce to smaller openings with reduced mass flow in mid or low capacity conditions. Thus, the volume of refrigerant exiting the crankcase is optimized across the range of operating conditions, creating significant benefits for the energy consumption of the air conditioning system.

The Denso SAS compressor initially used on the 2013 Cadillac ATS was evaluated using the methodologies that were developed and used during the SAE IMAC Cooperative Research Program for its evaluations of U.S. average system efficiency. These methodologies were subsequently adopted as SAE standards. The SAE J2765 standard specifies a series of bench tests at various compressor speeds to measure the system coefficient of performance (COP). Among these bench test conditions, 25 are then selected as inputs to the Global Refrigerants Energy and Environmental (GREEN) MAC Lifecycle Climate Change Performance (LCCP) model jointly developed for comparative evaluations by General Motors, EPA, the Japanese Automobile Manufacturers Association, and SAE. These 25 data points replicate a broad range

[350] "EPA Decision Document: Off-cycle Credits for Fiat Chrysler Automobiles, Ford Motor Company, and General Motors Corporation." U.S. Environmental Protection Agency. EPA-420-R-15-014. September 2015.

of operating conditions for various ambient climate conditions and air conditioner system modes. This LCCP model was adopted as the SAE J2766 standard.

The GREEN MAC LCCP model includes U.S. climate data for numerous U.S. cities as well as vehicle on-road operation parameters. Some of the key parameters are temperature and humidity data from a U.S. Department of Energy (DOE) database that contains U.S. National Climatic Data Center data, annual driving distances for each city from the EIA, and percentage of drive time at different ambient conditions based on research by the National Renewable Energy Laboratory (NREL). Combining the J2765 bench test COP data with the NREL, EIA and DOE climate and vehicle on-road data provides a simulation of annual U.S. average greenhouse gas emissions for an air conditioning system.

This full analysis was performed for the Denso SAS compressor with variable CS valve technology. The same analysis was then performed for the Denso SBU compressor, which is a modern EVDC design that does not have the variable CS valve. The SBU compressor was used at that time on a wide variety of vehicles. It qualified for the 1.7 grams CO_2 per mile MAC credit under the EPA regulation for an EVDC compressor with Reduced Reheat, and, as such, constituted a valid comparative baseline to determine if the SAS compressor with variable CS valve technology deserved an additional off-cycle credit for emission reductions beyond those already achieved by compressors that qualify for the EPA EVDC MAC credit from the pre-approved credit menu. (Both compressors also feature integrated oil separators, and both qualify for the MAC oil separator credit of 0.6 grams CO_2 per mile.) Using the techniques from SAE standards J2765 and J2766, an improvement percentage was estimated for the SAS compressor with the new technology. This improvement percentage was then applied to the baseline EPA estimate of U.S. MAC fuel usage of 14.3 grams CO_2 per mile to calculate that the SAS compressor with variable CS technology deserved an off-cycle credit of 1.1 grams CO_2 per mile.

This credit amount was also confirmed in vehicle AC17 tests which compared the energy consumption of the same vehicle when equipped with the SAS compressor to the SBU compressor. As was noted in the credit application, it was a very rare coincidence that this vehicle A-to-B AC17 testing could be conducted. In this case, General Motors happened to have two nearly identical compressors with the same mounting points, connection points, controls and other attributes–varying only in that the SAS compressor had the variable CS technology, while the SBU compressor did not.

Compressors with the variable CS valve technology are available in the marketplace for other automobile manufacturers, and the implementation of this beneficial technology could be accelerated throughout the industry if EPA made off-cycle credits for it more readily available. The benefits could be reliably assessed by each manufacturer solely using bench test data according to the SAE J2765 and J2766 standards. Instead, EPA has insisted that each manufacturer also conduct the more difficult vehicle AC17 A-to-B tests. The Alliance believes this is an unnecessary double layer of testing. The AC17 A-to-B testing has proven to be a prohibitive testing requirement for other manufacturers, since it is not typical for a manufacturer to have two nearly identical compressors that can be fitted into a test vehicle to measure the benefits of the variable CS valve. This is an example where EPA could simplify its requirements to improve operation of the off-cycle credit program, without reducing the integrity of the program in providing real-world emissions reductions. Note that the credit was calculated as a percentage of the conservative EPA 14.3 grams CO_2 per mile baseline for MAC usage, meaning that the real-world emissions reductions from the technology are likely more than the credited amount, making it especially unfortunate that this technology opportunity has not been expanded throughout the industry with more accessible off-cycle credits.

Even more problematic, the text of the Draft TAR raises another barrier which had not previously been encountered, when it makes reference to an apparently new requirement that new MAC efficiency technologies approved for credit under the off-cycle credit provisions will fall under the same MAC credit cap that had been created in the 2012 FRM based on the 40% improvement documented for the credit menu technologies that had been assessed by the 2006 IMAC cooperative research program. EPA states, "[a]pplications for A/C efficiency credits made under the off-cycle credit program rather than the A/C credit program will continue to be subject to the A/C efficiency credit cap."[351]

We believe that this Draft TAR statement has been made erroneously, since no limit of this type for new MAC efficiency technologies had ever previously been stated. The discussion about the cap in the RIA for the 2012 FRM was concerned with interactions among the technologies being evaluated at that time. These technologies had been collectively assessed in the IMAC cooperative research program to give an improvement on the demonstration vehicle of nearly 40%, whereas the individually assessed benefits used on the pre-approved credit list would add up in total to an improvement of over 40%. Specifically, there are a total of 7.1 grams of CO_2 per mile in potential indirect credits on the original 2012-2016 MAC indirect credit list, if the maximum were achieved in each category. This compares to a baseline of 14.3 grams of total MAC usage. The 7.1 grams would have equaled a reduction of 50% of the baseline, and so a cap that was established of 5.7 grams to limit the potential credits from these technologies to 40% of the baseline. It was never stated that this cap would also cover any additional MAC efficiency technologies which might be developed in the future.

Furthermore, it would be counterproductive to create such a limit on credits for future technologies, since it would forestall any improvements in MAC efficiency beyond the technologies which are already on the MAC indirect credit menu. Indeed, the cap on indirect

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[351] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 5-210.

MAC credits is already below the level that could be earned through maximum implementation of all the technologies on the current credit list, so there is already some loss of incentive to maximize the use of MAC efficiency technologies. These caps contradict and undermine the Agencies' statements that MAC technology developments will continue to expand and play an increasing role in overall vehicle GHG reductions.

Instead, off-cycle technologies that have been individually demonstrated to earn credits under the off-cycle program, by producing incremental emission reductions beyond those of the pre-approved technologies, should be free from the credit caps that were created seven years ago for the defined list of pre-approved technologies that were known at that time.

The General Motors analysis for the off-cycle credit for the SAS compressor with variable CS valve technology clearly showed that the energy savings were incremental to a baseline compressor (the SBU compressor) that had all of the compressor efficiency technologies on the MAC indirect credit pre-approved menu. In general, credit caps are counterproductive since they impede greater technology implementation. Certainly in the case of new MAC (or other off-cycle) technologies which have been specifically demonstrated to be incremental to the technologies on the pre-approved list, the caps created based on the pre-approved list should not be applied. In addition, there have been many new efficiency improvement technologies presented in various technical forums, such as at the SAE World Congress and the SAE Thermal Management System Symposium, which would increase efficiency significantly beyond the MAC indirect credit menu. Evaluations of some of these new technologies have been presented by National Laboratories such as NREL and Oak Ridge, in addition to presentations by automakers and MAC suppliers. These additional MAC efficiency technologies offer substantial additional greenhouse gas reductions, and Agency policies should try to encourage and incentivize rapid implementation of these improvements.

In summary, the MAC credit program has been a success in accelerating real-world emissions reductions, and MAC credits are essential for compliance with the EPA regulations. In fact, there is a strong basis to conclude the real-world benefits have exceeded the credited amounts. Creating the list of pre-defined and pre-approved credits was the cornerstone of this success, but the program should not be permanently limited to the technologies on the 2012 list. EPA should simplify and streamline its review and approval processes in order to create new credits for additional technologies under the off-cycle credit provisions, without maintaining prohibitive testing burdens for every case-by-case credit application. Also, the cap for the MAC indirect credits cannot be applied to include additional MAC efficiency technologies that may be developed in the future.

AC17 Test

The Draft TAR presents a fairly comprehensive and well-informed review of issues related to the AC17 test of MAC efficiency.[352] This reflects the close dialogue on these issues that EPA has maintained with the industry since the 2004-2006 IMAC SAE Cooperative Research Program and the subsequent early stages of development of the MAC indirect GHG credits. Continued dialogue and cooperation between the Agencies and industry is encouraged to assure the success of the MAC credit program. The Draft TAR review included the inherent test-to-test variability of the AC17 procedure, which can at times exceed the relatively small benefit of the technologies under consideration. It also referenced the impossibility in some cases of obtaining baseline MAC systems to use in conducting A-to-B testing to compare to a new and improved system. The overarching conclusions were that the evaluations of the AC17 procedure are not yet complete and are not yet conclusive.[353]

Stated slightly differently, the AC17 MAC efficiency test has not proven that it can play the role that EPA envisioned for it in their GHG regulation beginning in 2020 model year, when the A-to-B AC17 tests would need to show a differential sufficiently large for a manufacturer to apply the indirect MAC credit from the list of pre-approved technologies. There are too many testing difficulties for the AC17 procedure to function on a stand-alone basis in the way that traditional emissions certification tests measure compliance compared to a standard. Instead, the experience gained over the past few years with the AC17 procedure shows that it can best be used as a *supplement* to evaluations of the efficiency of an air conditioner technology, rather than as the sole basis for measuring efficiency.

Therefore, it can be expected that in almost every compliance submission beginning in 2020, manufacturers will need to submit an engineering analysis (rather than straightforward AC17 test results) in order to meet the A-to-B comparison requirements to justify their MAC indirect credits. This engineering analysis may or may not be supplemented with AC17 A-to-B testing of some or all of the technologies in the credit requests for each vehicle. The same logic applies to other uses of the AC17 test, such as for evaluating new MAC efficiency technologies as potential off-cycle credits, as was done by General Motors using the Denso SAS compressor with variable CS valve technology. The AC17 test can supplement these evaluations, but should not be used as an essential requirement for every credit submission. For example, the AC17 test only covers a limited set of the conditions that can occur in the real world, whereas future technologies may be developed that only provide their benefits in these other conditions not experienced in the AC17 test. Engineering analysis using bench test data or other approaches may be sufficient, or even superior, for these evaluations.

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[352] *Id.* at 5-209 et seq.
[353] *Id.* at 5-215.

The Draft TAR describes some of the activities being conducted through SAE to define other methodologies to support these A-to-B engineering analyses, such as SAE standards for bench testing the efficiency of an IHX (internal heat exchanger), an oil separator, an improved evaporator or condenser, or a blower controller.[354] It also describes the possibility of including some of these newer methodologies in a guidance document on this issue, which would be a useful document to bolster confidence for investment in these technologies.

It should be noted that other nations such as the Kingdom of Saudi Arabia and the Republic of Korea have adopted MAC indirect credit provisions into their new GHG regulations, patterned after the U.S. EPA regulation. However, the timing is different, and Saudi Arabia requires A-to-B testing as early as 2018, instead of the U.S. schedule to begin this requirement in the 2020 model year. This raises the urgency of clarifying and resolving these issues, such as by issuing an EPA guidance document within the next few months that could assist implementation in the U.S. as well as other nations that are following the U.S. regulatory format.

Finally, it should be remembered that the pre-approved credit list in the MAC indirect credit program has over the past several years been working very well to accelerate the implementation of more efficient air conditioner technologies. Due to its small baseline for MAC energy usage, the EPA methodology for creating these pre-approved credits was very conservative, and real-world emissions reductions likely exceed the credited amounts. Viewed from this perspective, the upcoming A-to-B testing requirements pose more of a barrier to these emissions reductions than they create an opportunity for improving the program. The 2020 AC17 A-to-B test requirement could create uncertainty over full achievement of MAC indirect credits that could hinder investment in MAC efficiency technologies. If compliance with the A-to-B requirements becomes overly problematic, there could be backsliding on the technological progress that is currently underway. The future success of the MAC credit program in generating emissions reductions will depend to a large extent on the manner in which it is administered by EPA, especially with respect to making the AC17 A-to-B provisions function smoothly, without becoming a prohibitive obstacle to fully achieving the MAC indirect credits.

Alternative Refrigerants and Refrigerant Leakage

As with the MAC indirect credits, the MAC direct credits have been a success in accelerating real-world GHG emissions reductions. The MAC direct credits are related to leakage of vehicle air conditioner refrigerants and the associated global warming impact of these chemicals. In the early years of the program, alternative refrigerants were not available, and credits could only be earned through tightened air conditioner systems that reduced leakage of the existing refrigerant, R-134a. This happened quickly, such that:

[354] *Id.* at 5-215.

> Leakage reduction improvements increased 69% to 10.3 million mega grams in only three years, from 2009 to 2012. The increase on a per vehicle basis was from approximately 3.5 grams per mile of CO_2 per vehicle in 2009 to approximately 4.0 grams per mile in 2012.[355]

Meanwhile, a new low GWP air conditioner refrigerant was developed, R-1234yf, which was introduced on new vehicles in the U.S. beginning in the 2013 model year. R-1234yf has a GWP approximately equal to CO_2, meaning its GWP is 1. Since there is a range of only one to three pounds of refrigerant in typical vehicle air conditioner systems, and this refrigerant charge provides for operation over many years, the use of a refrigerant with a GWP as low as that of R-1234yf essentially removes vehicle air conditioner refrigerants from the list of meaningful contributors to GHG emissions, and moves refrigerant direct emissions into a *de minimis* category, equating to only a few grams per year per vehicle of CO_2-equivalent.

Global production capacity for R-1234yf has increased steadily, and there are currently approximately 40 million vehicles on the roads globally using R-1234yf.[356] The incentive created by pre-defined MAC credits has accelerated the U.S. HFC reduction program into a leading position worldwide, laying the groundwork for eventual phase-down of high GWP automotive refrigerants. Building on the success achieved through the MAC direct credit program, in 2015, EPA changed the SNAP listing status of R-134a refrigerant, such that it will no longer be allowed on new light-duty vehicles in the U.S. beginning in the 2021 model year.[357]

Despite the success of the MAC direct emission credit program, there are opportunities for improvements to the regulations that would provide even greater success. For example, the caps on the low leak credits for each vehicle eliminate any incentive to use leak reduction technologies to the maximum extent. The leakage scores are calculated according to SAE standard J2727, which estimates leakage based on factors such as the lengths of air conditioner hose in the system, hose materials, number of joints, types of seals used for each joint, and the type of compressor shaft seal. Examination of the J2727 scoring system reveals how it is possible to use the best technologies in each category (for hose material choice, joint seal design, compressor shaft seal design, etc.) and achieve leak rates that are below the level that is granted the maximum EPA MAC low-leak emission credit. There is no good reason for the cap on low-

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[355] "Greenhouse Gas Emission Standards for Light-Duty Vehicles: Manufacturer Performance Report for the 2012 Model Year." U.S. Environmental Protection Agency. 2014. 29.
[356] An Estimated 18 Million Cars Using 1234yf by End of 2016. Chemours. Accessed September 26, 2016. https://www.chemours.com/Refrigerants/en_US/uses_apps/automotive_ac/SmartAutoAC/18-million-cars/index.html.
[357] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 10-48.

leak credits, since it limits the incentive to achieve the maximum achievable emission reductions in this area.

Finally, a penalty of up to 2 grams CO_2 per mile was put into the regulation for systems that use R-1234yf (or other low-GWP refrigerants) if they do not achieve certain low-leak levels. This penalty is overly large in comparison to the *de minimis* GWP impact of the refrigerant that could possibly leak under these circumstances. However, the main problem with these provisions is that the penalty system, created to maintain high levels of MAC system integrity, is not needed in view of the high cost of R-1234yf refrigerant. We believe that due to this high cost, the industry has adopted demanding specifications for R-1234yf system integrity in order to reduce warranty and other costs, compared to historical design standards for R-134a and R-12 systems. Thus, we believe that these provisions are a reporting burden that will not create any real-world benefits that could justify its existence.

Off-Cycle Credits

The Agencies have often acknowledged the benefits of providing the opportunity for manufacturers to generate off-cycle credits.[358] These technologies result in real-world benefits in reducing GHG emissions and fuel consumption that are not adequately captured on the current test procedures. The off-cycle program allows for additional compliance options and flexibilities that give manufacturers the opportunity for supplementary compliance actions. The off-cycle program is also in a unique position to incentivize technologies that may not otherwise be developed, due to not being fully represented on the two-cycle test procedure. These technologies have the potential to provide significant real-world reductions as the benefits are modeled around real-world conditions rather than a specified test procedure. Thus technologies which are demonstrated to provide real-world emission reduction benefits should be applicable to the off-cycle program.

Significant volumes of off-cycle credits will be essential for the industry in order to comply with the GHG and CAFE standards through 2025. The Agencies included off-cycle credits from only two technologies in their analyses for setting the stringency of the standards (engine stop start and active aerodynamic features). However, because the fuel consumption benefits of many other technologies were overestimated in the Agencies' analyses, and the standards were therefore set at very challenging levels, off-cycle technologies and the associated GHG and fuel economy benefits are viewed by the industry as a critical area that must become a major source of credits.

The early industry activity in this new category of regulation indicates its importance and shows the growing resources that are being shifted towards achieving emissions reductions using off-

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[358] *Id.* at 5-218.

cycle technologies. Following the first year of the pre-defined off-cycle credit menu, EPA noted that off-cycle credits had already become significant for some manufacturers, and that some would be expected to reach eventually the 10 gram cap for credits from the pre-approved off-cycle credit list.[359] In fact, the U.S. total fleet average off-cycle credit level is reported to be 2.3 grams CO_2 per mile in 2014.[360] This is much higher than the level of off cycle credits five years previously, in the first year of the LDV GHG regulatory program.

The creation of the pre-approved credit list for 2014 and later years has become the source of the greatest success for the off-cycle credit program. This list of pre-defined and pre-approved credits is stimulating widespread investment by the industry in emission reduction technologies which would not have been impacted by the traditional two-cycle, city/highway, fuel economy regulatory framework that has existed for the past 40 years. This growing dedication of resources by the industry to the pre-approved technologies on the list can be expected to greatly accelerate the pace of technology improvements in the next several years.

The most important off-cycle priority going forward will be to maintain the reliability and credibility of the pre-defined technology credit list as the basis for making these long-term investments in new technologies. In part, this means during the administration of the off-cycle compliance reporting process not inserting additional unanticipated requirements or restrictions such as performance testing, caveats or narrow interpretations of the technology definitions. The technology definitions in the regulation were created with an intention to be broadly inclusive of experimentation and differing approaches by the various manufacturers in this new area of regulatory activity. At this time, at least through the first stages of building the off-cycle program, this concept of openness to differing approaches should be maintained. As credit opportunities are identified and become proven, new technologies can be expected to be implemented, and then continuously improved. The industry needs to be able to rely 100% on the pre-defined and pre-approved off-cycle technology credit list as the basis for making investments to implement these technologies.

The Alliance's recommendations related to off-cycle credits include the following:

- The caps on off-cycle credits from the pre-approved list should be eliminated.
- If the off-cycle credit caps are not eliminated, they could be made less constraining if they were administered as fleet average credit caps, rather than per-vehicle caps.
- Off-cycle credit applications should be simplified and processed more quickly.
- EPA should examine additional technologies for potential inclusion onto the list of pre-approved off-cycle credits.

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[359] *Id.* at 5-223.
[360] "Greenhouse Gas Emissions Standards for Light-Duty Vehicles: Manufacturer Performance Report for the 2014 Model Year." EPA-420-R-15-026. December 2015. 40. Table 3-21.

- EPA should revisit certain technologies to increase their credit values, such as stop-start, in view of the considerable information on higher real-world idle times that has been gained since the original default stop-start credit was calculated for the pre-approved credit list.
- EPA and NHTSA should begin the technical studies to support the next generations of innovative fuel savings technologies, and develop off-cycle credit frameworks to accelerate their implementation.
- The program could be further stimulated through the use of credits for the early achievement of especially ambitious goals.
- EPA should consider adopting certain eco innovation greenhouse gas technologies approved by the European Union (E.U.) into the off-cycle credit system.
- EPA should revisit the minimum penetration thresholds and the required CO_2 improvement thresholds within the advanced technology pickup program and should extend the credits beyond their current timeframe; we also recommend that the Agencies consider whether this technology should be applied to other light-duty trucks.
- EPA and NHTSA should begin the technical studies to support the next generations of innovative fuel savings technologies associated with safety and congestion mitigation from improved vehicle-to-vehicle and vehicle-to-ground communication, as well as from car-sharing and car-hailing services, and develop off-cycle credit frameworks to accelerate their implementation prior to model year 2026.

These issues are explained in further detail below.

Credit Caps

With the pre-approved credit list properly administered, the off-cycle program can be expected to grow toward the credit caps that were established in the regulation, and these credit caps will become binding constraints for many or most automobile manufacturers. At that point, the credit caps will be counterproductive since they will impede greater implementation of the beneficial off-cycle technologies.

Some hypothetical scenarios reveal how easily a manufacturer could be constrained from maximum implementation of off-cycle emissions reduction technologies by the 10.0 grams CO_2 per mile fleet average cap that was set for credits from the pre-approved list. Passenger cars typically have smaller off-cycle credits than the truck credits on the list. Even so, a manufacturer would exceed the 10-gram cap if it implemented on all its cars a program to apply across-the-board stop-start (2.5), active grill shutters (at the 0.6-gram effectiveness level modeled by EPA), active powertrain warm-up on both the engine and the transmission (3.0), thermal management technologies at the maximum 3.0-gram cap for that category, and LED external lights (1.0). This would leave unimplemented at least 4.0 grams CO_2 per mile in other available passenger car off-cycle credits for other technologies.

While passenger cars could thus be somewhat constrained by the off-cycle credit cap, the credit cap constraints are much more severe for trucks, since the truck credits are bigger. A truck with only stop-start (4.4) and active aerodynamic features (1.0) would already be at a 5.4 grams CO_2 per mile credit level. Adding thermal management technologies at the maximum cap for that category (4.3) brings the truck credit total to 9.7 grams — just short of the 10.0-gram cap. If the truck had all the technologies from the previous passenger car scenario, adding active powertrain warm-up (6.4) and LED lights (1.0), the truck would be at a credit level of 17.1 grams CO_2 per mile, and (as in the passenger car scenario) there would still be remaining unimplemented technologies worth at least another 4.0 grams.

These hypothetical scenarios show that the off-cycle credit caps could easily become binding for a manufacturer that tried to implement a comprehensive program to apply these technologies across its fleet and earn the associated credits, especially if that manufacturer had a significant portion of trucks in its fleet. Because of the critical importance of off-cycle credits amidst the challenge of the 2025 standards, these types of comprehensive programs to pursue these credits are emerging, as the industry has demonstrated by earning credits faster than initially assumed in the EPA analysis. Going forward, the 10.0 gram CO_2 per mile cap on total off-cycle credits from the pre-approved list is likely to become counterproductive, as it limits the incentive for manufacturers to implement off-cycle emissions reduction technologies to the maximum possible extent. This 10.0-gram cap serves no beneficial purpose and is even likely to become counterproductive, and should therefore be eliminated.

Similarly, the caps on thermal management technology credits can be expected to become a binding constraint that will limit the incentive to implement these technologies, possibly causing manufacturers to stop short of the maximum possible usage of these beneficial technologies. Once again, some hypothetical scenarios can provide perspective on how easily a manufacturer could become constrained by the thermal management caps. For passenger cars, the maximum thermal management glass credit is 2.9 grams CO_2 per mile, which is almost equal to the 3.0 grams cap for all thermal management technology credits for passenger cars. So the credits available in the thermal management category could conceivably be nearly exhausted solely by a comprehensive program at a manufacturer to adopt solar management glass at the maximum credited level. This would leave unimplemented up to 3.4 grams in potential credits from other thermal management technologies such as cooled seats (1.0), solar reflective paint (0.4), and active cabin ventilation (2.1).

A similar situation exists for trucks, where the maximum credit for solar management glass (3.9) almost reaches the total cap of 4.3 grams allowed for all thermal management technologies. A comprehensive program by a manufacturer to implement the maximum credited levels of solar management glass technology would leave unimplemented up to 4.2 grams in potential credit from other thermal management technologies such as cooled seats (1.3), solar reflective paint (0.5), and active cabin ventilation (2.8). Alternatively, to the extent a manufacturer chose to implement cooled seats, solar reflective paints, and cabin ventilation, the manufacturer would be constrained by the cap from implementing maximum levels of solar management glass technology.

As with the 10.0-gram cap on total off-cycle credits from the pre-approved list, the caps on thermal management technology off-cycle credits are likely to become counterproductive as they limit the implementation of beneficial emission reduction technologies. These caps should ideally be eliminated. Alternatively, if the thermal management off-cycle credit caps are not eliminated, they could be made less constraining if they were administered as fleet average credit caps, rather than per-vehicle caps. The detail of whether these should be fleet average or per-vehicle caps was not specified in the regulation, and EPA has chosen to adopt the more restrictive interpretation that these thermal management credit caps should apply to each individual vehicle. This interpretation has proven to be particularly troublesome to implement since the database and accounting systems for compliance reporting have not typically been constructed to check whether credit caps have been reached on each individual vehicle. Instead, these systems are typically constructed to compile fleet totals and fleet averages for each type of technology feature, and these totals can be compared relatively easily to a fleet average cap. In contrast, checking the cap on each vehicle requires going back to each vehicle VIN to check the individual equipment level for each vehicle, which is a laborious task that can be expected to become increasingly difficult as rising technology implementation brings more vehicles to the cap.

The EPA interpretation of how to implement thermal management credit caps should be revised to partially alleviate the counterproductive constraints from the caps by implementing the cap on a fleet average basis, instead of implementing the cap on each vehicle.

Additional Off-Cycle Technologies

While the pre-approved off-cycle credit list created for 2014 has been a success, other aspects of the off-cycle credit provisions have been underperforming. As described in the Draft TAR, only a few special applications for off-cycle credit have been approved under the other two pathways for earning credit. These two pathways are using either five-cycle testing or using an alternative methodology that is posted for public comments. The industry needs the off-cycle credit program to function effectively to fulfill the significant role that will be needed for generating large quantities of credits from this type of emission reduction. This means that off-cycle credit applications should be processed more quickly and with fewer barriers. Credit applications are requiring extensive time and data, testing and other demonstration requirements are sometimes excessive.

In principle, procedures should be simplified and standardized, and data (where appropriate) from one manufacturer's application for a technology should be used generically for similar applications from other manufacturers relative to the same technology. This will not only reduce barriers to implementation, it will help ensure a level playing field among manufacturers and give manufacturers and suppliers some assurances when deciding to invest in these technologies.

One example would be the variable CS valve technology, previously discussed, that received off-cycle credit in an application under pathway three by General Motors. The benefits of this technology would not be expected to vary significantly due to vehicle-specific controls or other vehicle-specific attributes, and there should not be a great need for additional testing to confirm the benefits for additional applications of the technology by other manufacturers, especially since the credit was approved for General Motors at a conservative amount under the "worst case" test conditions of a using small displacement compressor (at the low end of the range of sizes used by General Motors). Yet no additional credits have been approved for the use of this technology by other manufacturers in the year since the General Motors credits were approved by EPA, which occurred on September 1, 2015.

EPA has adopted a position that other manufacturers must gather test data to generally the same extent performed by General Motors in order for EPA to review other applications for the same technology on a case-by-case basis. In practice, this testing requirement has proven to be a prohibitive barrier to the spreading of off-cycle credit incentives for other companies to accelerate adoption of this beneficial technology. There should be some way to establish simplified procedures for credit approvals which avoid this type of outcome. For example, in this case, additional approvals might be based on some simplified usage of supplier bench test data for additional compressors that use the variable CS valve technology. Ideally, EPA could provide language in the MTE process that once an off-cycle technology credit is approved for the first manufacturer, EPA allow for the use of the credit by all manufacturers for the same or similar technologies through a simple guidance letter.

To accelerate processing of off-cycle credit requests, the automakers have petitioned that EPA and NHTSA consider providing for a default acceptance of petitions for off-cycle credits, provided that all required information has been provided. [361] Limited Agency resources have delayed the processing of these petitions, and the delay impedes manufacturers' ability to plan for compliance or make investment decisions. Streamlining the process in this manner has therefore been suggested.

Many additional off-cycle technologies have been recommended by the Alliance in past rulemaking processes for inclusion on the list of pre-approved credits. Some of these include: high efficiency alternators, axle heaters, eco buttons, air conditioner compressors with the variable crankcase suction valve, transmission bypass valves, automatic tire inflation, adaptive cruise control and other safety and driver assist technologies, such as navigation systems and

[361] "Petition for Direct Final Rule with Regard to Various Aspects of the CAFE and GHG Program," Submitted to EPA and NHTSA, June 20, 2016.

autonomous driving technologies, electrified accessories, and pickup tonneau covers. As a part of the midterm review process, EPA should revisit the examination of these technologies for potential inclusion onto the list of pre-approved off-cycle credits (or generalized pre-approval through guidance letter), and increase the cap accordingly to reflect the increased potential for fuel consumption reduction. At the same time, EPA should revisit certain technologies to increase their credit values, such as stop-start, in view of the considerable information on higher real-world idle times that has been gained since the original default stop-start credit was calculated for the pre-approved credit list.

Looking farther into the future, EPA and NHTSA should begin the technical studies to support the next generations of innovative fuel savings technologies, and develop off-cycle credit frameworks to accelerate their implementation. For example, the Agencies should study the credit potential for innovative safety and congestion mitigation technologies, such as improved vehicle to vehicle (V2V) and vehicle to grid (V2G) communications, car-sharing services, and car hailing services (e.g. Lyft).

The program could be further stimulated through the use of additional credits for the achievement of especially ambitious goals. For example, additional credits could be established for achievement of accelerated technology roll-out goals, technology fleet penetration goals or other objectives (e.g. credit for 85% implementation of a technology such as start-stop on an OEM fleet, credits for early introduction of safety/congestion mitigation technologies). Additional credits could also be established for early phase-out or other limits on features with adverse off-cycle fuel economy, emissions, or other impacts.

Eco-Innovations

A big breakthrough in international harmonization of regulations could be achieved if eco innovation GHG technologies approved by the E.U. were automatically adopted into the EPA system. This would essentially be an additional list of pre-defined and pre-approved off-cycle credits. The eco innovations regulatory provisions and the associated technologies are a feature of the E.U. light-duty greenhouse gas regulatory program, and generally correspond to the off-cycle provisions of the U.S. regulation. Credit applications for eco innovation technologies are thoroughly reviewed by the European Union's Joint Research Center, which provides the technical expertise to grant appropriate credits. The E.U. rules for eco innovation credits are very restrictive, and the review process is arduous, and as a result the volume of eco innovation credits granted has been low. However, this difficult review and approval process means that the eco innovation credits which are approved can be relied on as incentivizing technologies which produce thoroughly verified real-world GHG reductions.

Thus far, the E.U. has granted eco innovation credits for efficient alternators, engine compartment encapsulation, enthalpy storage tanks, efficient lighting (already on the EPA list), solar panels (already on the EPA list), engine-off coasting technology, and navigation-based battery preconditioning. The credits are generally based on an eco-innovation template that provides test procedures and a generic calculation of the credit for all manufacturers that adopt the technology.[362]

Advanced Technology Incentives for Large Pickups

The Draft TAR recounts the full size pick-up truck incentives as provided in the 2012 FRM, but does not evaluate the provision's effectiveness in promoting the adoption of "game changing" technologies as intended.[363] We believe that for the provisions to provide a meaningful incentive that meet the Agencies objectives, the eligibility criteria needs to be less restrictive and the scope expanded beyond full size pick-up trucks.

The 2012 FRM provides incentives for full size pick-up trucks with hybrid systems, and other technologies that significantly reduce CO_2 emissions and fuel consumption. The Agencies focused the flexibility on full-size pickup trucks because of the challenge the MY2017–2025 standards will present for large vehicles, including full-size pickup trucks, that are often used for commercial purposes and must maintain utility, towing and payload capability. The Agencies' stated intent of these provisions is to incentivize the penetration of ''game changing'' technologies for large pickup trucks into the marketplace. The incentives were also intended to create an opportunity in the early years of the MY2017-2025 program to begin penetration of advanced technologies into large pickup trucks, which in turn could enhance the chance for achieving the more stringent later year standards for those vehicles.[364]

The challenges of meeting the MY2022-2025 standards and in applying advanced technologies such as hybridization extend beyond just full-size pickup trucks

As discussed in the summary to these comments, it is clear that hybrid technology in particular does not just hold game changing potential for full size pick-up trucks; it will be a necessity across the fleet in order to attain compliance with MY2022-2025 standards, and will be needed at greater penetration rates than the Agencies have projected.

The challenge will be in achieving hybrid technology deployment in the volumes needed for compliance considering the technology's associated cost premiums increase exponentially with increased vehicle weight and utility requirements as can be seen in Figure G-1 below.

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[362] http://ec.europa.eu/clima/policies/transport/vehicles/cars/documentation_en.htm.
[363] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at p. 11-6 et seq.
[364] *Id.* at 11-6.

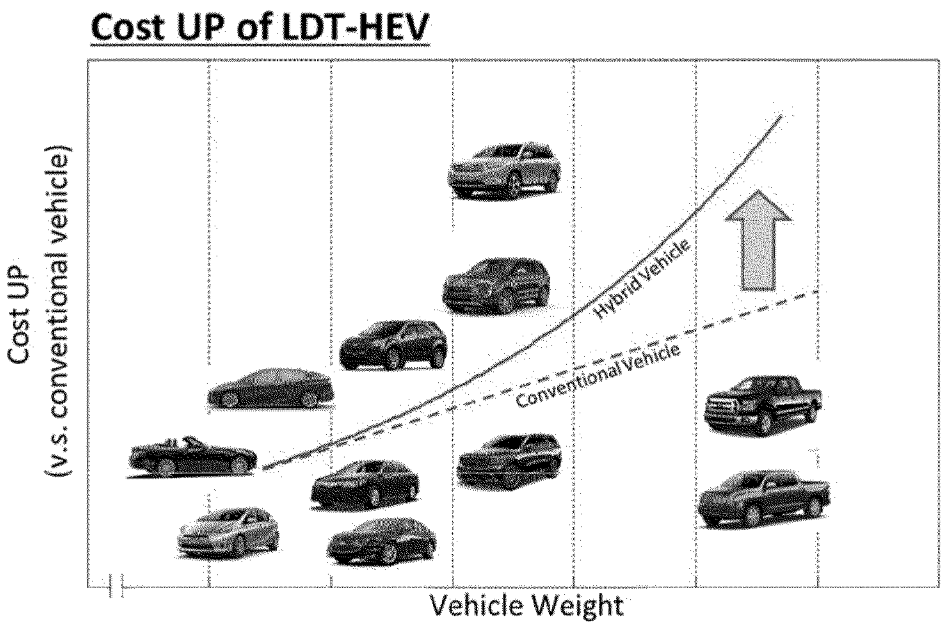

Figure G-1: Generic Cost Diagram Demonstrating Exponential Increase of Strong Hybrid Technology With Vehicle Weight

The Agencies noted in the 2012 FRM that:

> Although there may not be inherent reasons for a lack of hybrid technology migration to large trucks, it is clear that this migration has nevertheless been slow to materialize for practical/economic reasons, including in-use duty cycles and customer expectations. These issues still need to be addressed by the designers of large pickups to successfully introduce these technologies in these trucks, and we believe that assistance in the form of a focused, well-defined incentive program is warranted.[365]

We believe system capability and cost present the primary hurdle to the migration of hybrids to full-size pickup trucks, and contend that the technology capability, cost, and customer acceptance challenges are not unique to that segment of the light-duty truck fleet. In fact, more full-size pickup trucks have employed hybrid technology than full-size SUVs or minivans. The great disparity between passenger car and light-duty truck hybrids is demonstrated in Figure G-2 below.

[365] 77 Fed. Reg. 62739 (Oct. 15, 2012).

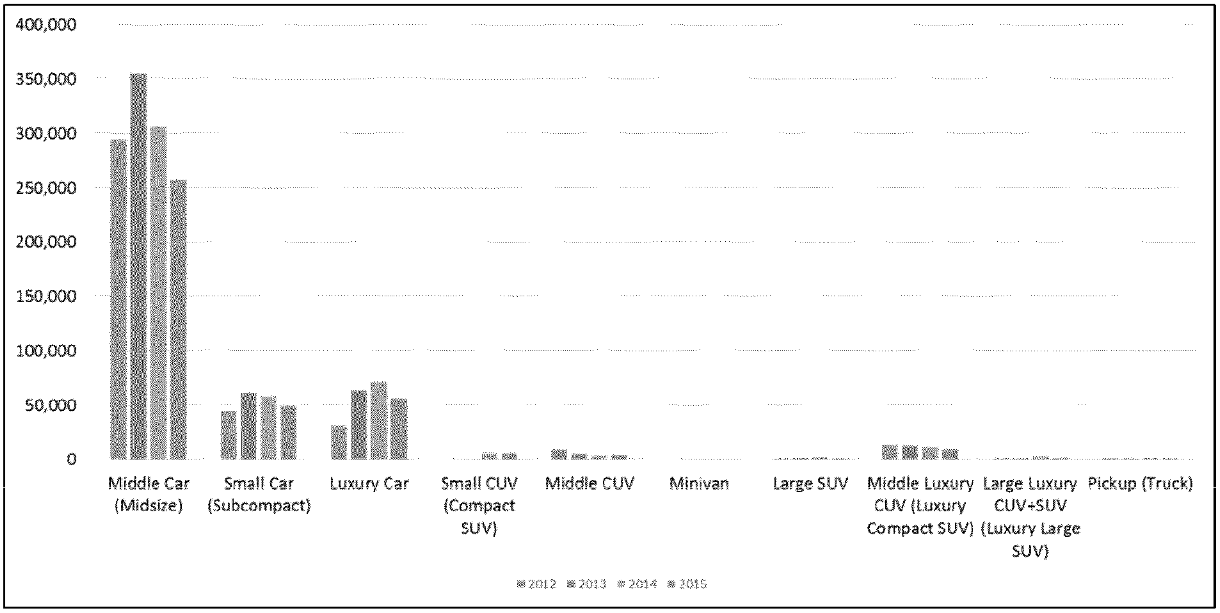

Figure G-2: Hybrid Sales by Vehicle Segment[366]

The utility challenge for many SUVs and smaller pickup trucks is similar to that for full-size pickups. The Agencies note in the final rule that some non-pickup light-duty trucks do have substantial towing capacity, but go on to say they not believe an incentive was warranted because most are not used as towing vehicles, in contrast to full-size pickup trucks that often serve as work vehicles.[367] We contend the frequency of towing or work operation is irrelevant in determining hybrid system design requirements. System design and the resulting costs are determined by the worst case or most severe conditions anticipated. If only 10% of SUVs or other non-pickup LDTs are used for towing, the hybrid system for every vehicle in a given model must still be designed for that 10% usage condition.

In restricting the provision to full-size pickup trucks in the final rule, the Agencies contend that smaller footprint trucks fall on the lower part of the truck curve, which have a higher rate of improvement (in stringency) than the larger trucks, thus making them more comparable to cars in terms of technology access and effectiveness [368] (which also do not have access to the incentives discussed here). While these smaller footprint trucks may not entail the duty-cycle requirements associated with full-size pickups and larger non-pickup light-duty trucks, they all offer greater utility than a passenger car and the stringency of the applicable standards for these smaller footprint trucks create their own significant challenges even for hybrid technology. Furthermore, many of the conventional powertrain efficiency and vehicle tractive energy improvements such

[366] Ward's Automotive
[367] 77 Fed. Reg. 62739 (Oct. 15, 2012).
[368] *Id.*

as engine downsizing, turbocharging, and mass reduction actually provide a comparatively greater benefit for the larger heavier truck segments and are hence more cost effective for the larger pick-up trucks.

Promoting hybrid technology in the smaller light-duty truck segments, precisely because of the less severe utility requirements, offers a more cost-effective proving ground that can provide valuable experience about hybrid truck requirements and customer preference that is transferrable to the design process for the full size pickup and larger non light-duty truck segments. Building the customer base for hybrids in the lighter truck segments can help promote the eventual adoption/acceptance in the more challenging larger truck segments. That said, cost does remain a hurdle for acceptance of hybrids in the smaller, lighter truck segments. All of this warrants some level of incentive for hybrids beyond the large pickup truck segment.

The penetration rate-based eligibility requirements for the advanced technology pickup truck incentives are too restrictive

It is unlikely the advanced technology full-size pickup truck incentive provisions, as currently designed, will achieve their stated objectives. The 2017 model year has started and there is no indication that manufacturers will pursue these incentives. One likely reason is because the penetration rate eligibility criteria is too restrictive and ignores the longstanding industrywide practice of carefully introducing new technology into the market, especially those that entail cost premiums, performance challenges and possible customer acceptance issues.[369]

Technology uptake typically follows an S-curve pattern. Deployment after introduction starts at a slow pace aimed at a niche market where acceptance is gauged and necessary improvements are learned and implemented. Once manufacturer and customer confidence is gained, rapid growth occurs as deployment is scaled up toward mainstream volumes. Eventually penetration rate increases tail off as the technology saturates the market to the degree desired by customers.

Figures G-3 and G-4 show that this gradual growth often takes a decade or more to reach a percent 10% market share (the required eligibility threshold for the strong hybrid advanced technology full-size pickup truck incentive). The technologies in Figures 7-3 and 7-4 are significantly less expensive than the application of strong hybridization to the light-duty truck fleet. All of this makes the expectation of 10% sales of strong hybrids at the time of introduction within any given model unrealistic and counterproductive to the goal of increasing hybrid penetration in the truck market. The total hybrid share in the U.S. market has never been

[369] We note that the addition of hybrid technologies entails challenges to meeting customer expectations. For example, large batteries can add mass, requiring additional engineering and cost to maintain expected payload and towing capabilities. Additionally, off-road applications may require additional sealing to prevent dirt or water intrusion.

higher than 4%. For models that contain both a hybrid and non-hybrid variant, as seen in Figure G-5, the average hybrid share as of May 31, 2016 is 6.2% for 2016 MY light-duty trucks.[370]

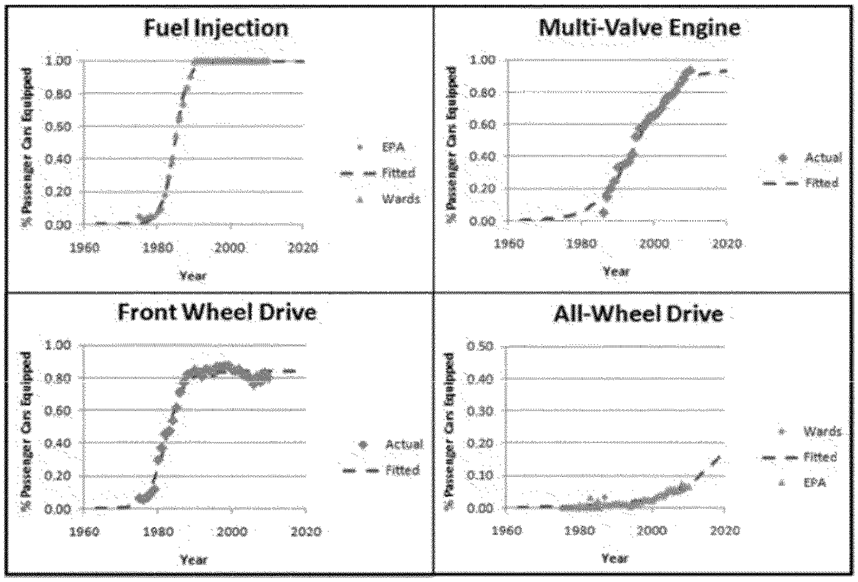

Figure G-3: Technology Deployment Rates for Fuel Injection, Multi-Valve Engine, Front Wheel Drive, and All-Wheel Drive[371]

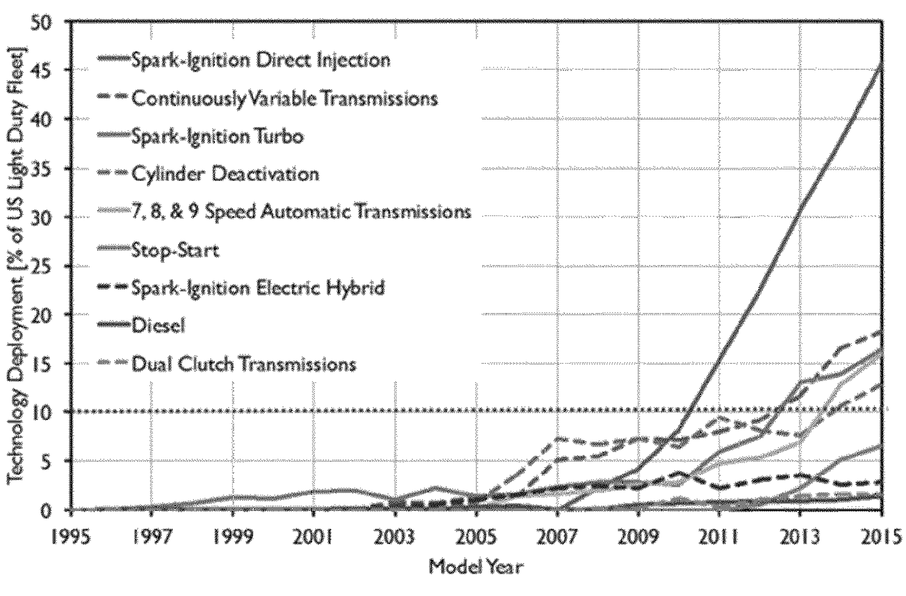

Figure G-4: Light-Duty Truck Hybrid Sales Share[372]

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[370] Polk

[371] Stephen M. Zoepf. "Automotive Features: Mass Impact and Deployment Characterization. Massachusetts Institute of Technology. June 2011.

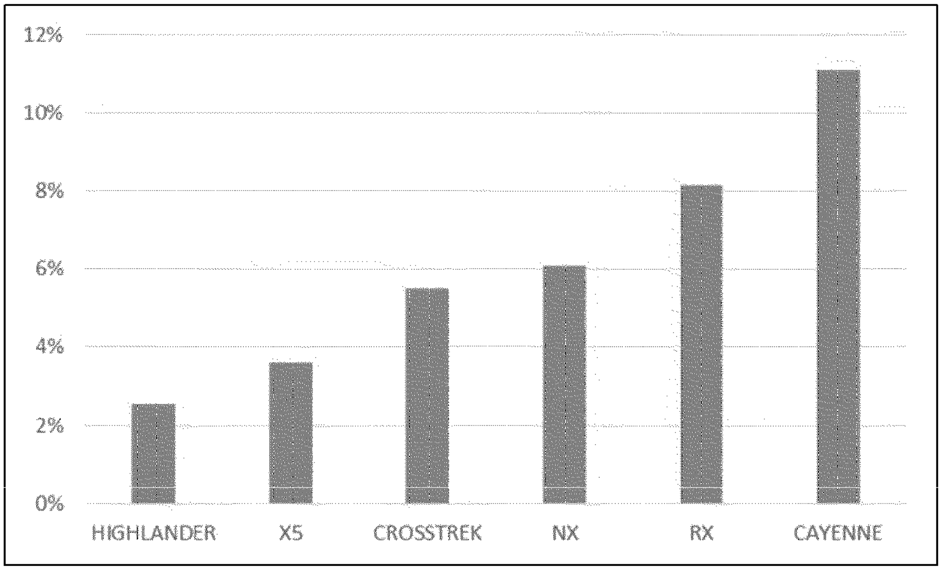

Figure G-5: Light-Duty Truck Hybrid Sales Share[373]

The current eligibility threshold is inconsistent with the Agencies' stated goal of fostering production of these technologies at levels that will help achieve economies of scale, promote greater fuel savings overall, and make these technologies more cost effective and available in the MY2022-2025. Therefore, the eligibility threshold should be eliminated. It would be more appropriate to consider a maximum threshold above which the technology's stability in the market would be considered to no longer warranting an incentive.

Hybrids Offer Transition to Greater Levels of Electrification

As stated previously, the Alliance contends that more hybrids or other forms of electrification will be needed to comply with the MY2022-2025 standards than assumed in the Draft TAR. The Alliance also recognizes that the stringency of CAFE and GHG standards will likely increase beyond MY2025 as the need to address climate change and energy security will continue. While conventional gasoline powertrains will continue to play an important role beyond MY2025, post-MY2021 powertrain investments are expected to increasingly involve hybrids and other forms of electrification as a necessity. Hybrids can also aid on the transition to PHEVs, EVs, and FCs.

In the Draft TAR, EPA explains that CNG vehicles are not viewed as a game changing technology from a GHG tailpipe emissions perspective. Nonetheless, EPA included a multiplier

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[372] "MY 2015 Baseline Study." Novation Analytics. 2016. And "Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975-2015." U.S. Environmental Protection Agency. EPA-420-R-15-016. December 2015.
[373] Polk

incentive for dedicated and dual-fueled CNG vehicles because EPA considered investments in CNG technology and refueling infrastructure to be a valuable, indirect step towards hydrogen FCVs, which can be a game-changer in terms of GHG emissions. In this way, EPA believed that CNG could be a critical facilitator of a next-generation technology.[374] The same logic applies to hybrids as they can help build the industrial base required for electric vehicles which share common components (motors, power control systems, etc.) and production techniques as well as help socialize the market for greater levels of electrification. Even viewed as a bridge technology, conventional hybrids can provide game changing GHG reductions and should be considered for at least some level of technology incentive in light-duty trucks beyond just full-size pickup trucks.

Electric Vehicle Upstream Emissions

With regard to upstream emissions, the Alliance recommends that EPA permanently allow automobile manufacturers in their compliance accounting for this regulation to attribute 0 grams of CO_2 per mile for the upstream emissions associated with generating electricity used as a transportation fuel. This is a critically important revision to make at this time, as manufacturers anticipate that PEVs and fuel cell vehicles (FCVs) will need to play a much larger role in meeting standards through 2025 than forecast in the Draft TAR.

The MTE was designated at the time the 2017-2025 regulation was issued as an appropriate point to review the inclusion after 2021 of upstream GHG emissions from electric power generation in the accounting for emissions of plug-in electric vehicles, as well as the upstream emissions for fuel production for fuel cell vehicles.[375] As was noted in the 2012 FRM, "traditionally the emissions of the vehicle itself are all that EPA takes into account for purposes of compliance with standards set under Clean Air Act section 202(a)."[376]

Despite EPA's tradition of not including upstream emissions in measuring compliance with vehicle standards, EPA attempted to achieve a complicated balancing of considerations in the 2017-2025 rule for PEVs and FCVs. On the one hand, EPA wished to extend incentives to encourage the commercialization of PEVS and FCVs, since these technologies were judged by EPA to "have the potential to achieve game-changing GHG emissions reductions in the future."[377] Toward this end, the 2017-2025 regulation created a schedule of multiplier credits for

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[374] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 11-6, 11-7.
[375] 77 Fed. Reg. 62623, 62820 (Oct. 15, 2012).
[376] *Id.* at 62816.
[377] *Id.* at 62813.

PEVs and FCVs through 2021. Also through 2021, PEVs and FCVs could include 0 grams CO_2 per mile in their compliance accounting for upstream emissions incurred to create and distribute their fuels. However, after 2021, EPA created volume thresholds that would trigger a switch in PEV and FCV compliance accounting, whereby PEVs and FCVs would move from a framework of favorable incentives into an unusually disfavored status, losing their multipliers while also becoming the only vehicles that would be hit with an unfavorable upstream emissions factor to account for the additional emissions used to create and distribute their fuels, compared to gasoline. This disfavored status would be applied consistently for all manufacturers by 2026, regardless of whether the volume thresholds had been reached.[378] There is an obvious inconsistency in this switch after 2021, changing from incentivizing electric vehicles and fuel cell vehicles to encourage their commercialization, and instead dis-incentivizing them through the revised upstream emissions accounting treatment. It should be noted that in a rare departure from maintaining strict harmonization, Canada has revisited EV, FCV, and PHEV multipliers; increasing and extending them to further incentivize their introduction into the market.

In contrast, EPA declined to create multipliers or other adjustments to favor LPG or advanced diesels[379] or biofuels.[380] This was based on EPA's judgment that these technologies would not be fundamentally "transformative" with respect to vehicle GHG emissions. Instead, EPA applied their traditional approach of regulating the tailpipe emissions associated with these fuels, with no adjustment for their upstream impacts. This was a major setback for biofuels, where the upstream GHG impacts are generally considered to be significantly favorable, such as estimated under the California Low Carbon Fuels Standard.[381] This creates yet another inconsistency under the current EPA regulation, since no credit is given for the favorable upstream impacts of biofuels (or diesel, or any other fuel which could claim lower upstream emissions than gasoline), yet electric vehicles and fuel cell vehicles are penalized for the unfavorable upstream emissions attributed to their fuels.

EPA offered the justification that upstream GHG emissions for transportation fuels production and distribution was not directly and comprehensively regulated, and should therefore have been regulated indirectly by way of the vehicle GHG standards:

> At the time of the final rule, however, there was no such comprehensive program addressing upstream emissions of GHGs...Therefore, EPA placed limits on the use of 0 g/mile for MY2022-2025 vehicles and the use of 0 g/mile is currently not allowed after MY2025. EPA included per-company vehicle production caps for

[378] *Id.* at 63181.
[379] *Id.* at 62822.
[380] *Id.* at 62824.
[381] "Low Carbon Fuel Standard." State of California Air Resources Board. Accessed September 26, 2016. https://www.arb.ca.gov/fuels/lcfs/lcfs.htm.

> use of 0 g/mile in MYs 2022–2025, and 0 g/mile cannot be used for production that exceeds these caps….Once the production cap is met, the manufacturer must include net upstream emissions associated with electricity generation on a g/mile basis in their compliance calculations.[382]

However, EPA has subsequently acknowledged that conditions have changed, and that the primary basis for including upstream emissions for PEVs and FCVs after 2021 has now been removed:

> EPA recognized that the mid-term evaluation would provide an opportunity to review the status of advanced vehicle technology commercialization, the status of upstream GHG emissions control programs, and other relevant factors. At the time of the MY2017-2025 final rule, part of the rationale for including upstream emissions associated with electricity production, for production volumes in excess of the per-company production volume caps, was because these upstream GHG emissions values are generally higher than the upstream GHG emissions values associated with gasoline vehicles, and because there was then no federal program in place to reduce GHG emissions from electric power plants….Since the MY2017-2025 final rule, EPA has adopted GHG controls for electricity generation. On August 3, 2015, EPA issued final GHG emissions regulations addressing both existing (referred to as the Clean Power Plan) and new electricity generating units. These rules are expected to markedly decrease GHG emissions associated with future electricity generation.[383]

The Clean Power Plan, although currently tayed by the U.S. Supreme Court, is a comprehensive EPA program that aims to reduce GHG emissions from electricity generation facilities by 32% in 2030, compared to 2005 levels. It creates a complex framework for states to create their own statewide implementation plans to meet the wide range of individual emission reduction targets assigned to them by EPA. While the aggregate emissions reductions of this new program should be large and unprecedented, there are many unresolved issues and uncertainties, and the changes in the generation sector can be expected to be much greater than experienced or contemplated in the past. In view of these uncertainties and the dramatic changes expected in the electricity generation sector, reliable upstream emissions factors for the next ten years cannot be created at this time to attribute to electric vehicles under the light-duty vehicle GHG regulation. However, if they could be reliably estimated, they would be expected to be falling rapidly due to the new

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[382] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 11-7.
[383] *Id.* at 11-7.

Clean Power Plan, such that the additional upstream emissions premium from this fuel pathway compared to gasoline could be vanishing, or reaching very low levels.

In summary, the creation of the Clean Power Plan to comprehensively regulate and significantly reduce GHG emissions from the electricity generation sector has removed the primary rational for EPA to include upstream emissions factors in its GHG compliance framework for electric vehicles. Removing these PEV upstream emissions factors would return EPA to its traditional framework for regulation of vehicle emissions, which included only emissions from the actual vehicle. It would also make regulation of electricity as a transportation fuel consistent with regulation of other fuels (such as biofuels), and would remove a regulatory disincentive to the commercialization of electric vehicles. Finally, removing the upstream emissions factors for electric vehicles allows EPA to avoid the immense difficulty of fairly estimating future emissions factors amidst anticipated rapidly changing conditions in the electricity generation sector. Therefore, the Alliance recommends that EPA permanently allow automobile manufacturers, in their compliance accounting for this regulation, to attribute 0 grams of CO_2 per mile for the upstream emissions associated with generating electricity used as a transportation fuel. This is a critically important revision to make at this time, as manufacturers anticipate that PEVs and FCVs will need to play a much larger role in meeting standards through 2025 than forecast in the Draft TAR.

NHTSA and EPA Harmonization

On June 20, 2016, the Alliance and Global Automakers petitioned EPA and NHTSA to make several regulatory changes to better harmonize their respective regulations for GHG and FE. The issues raised in this petition are relevant for the MTE and the Draft TAR because of many interactions with the assessments of this review.[384]

For example, it was requested in the petition that EPA and NHTSA calculate the fuel economy for a manufacturer's fleets for MY2010-2016, to account for off-cycle technologies at the same levels and in the same way as EPA accounts for those technologies in the GHG program. This would be consistent with the procedures for both NHTSA and EPA in 2017-2025, and doing so would not erode the overall benefits of the CAFE standards or the ONP.

Similarly, the Alliance and Global Automakers requested the Agencies calculate the fuel economy for a manufacturer's fleets for MY2010-2016 to account for air conditioning efficiencies at the same levels and the same ways as EPA is accounting for those efficiencies in the GHG program. The Alliance and Global Automakers provided an approach that would grant such credits while also accounting for the differences in the stringency of the GHG and CAFE

[384] Letter from C. Nevers to Mark Rosekind, PhD and Gina McCarthy re: Petition for Direct Final Rule with Regard to Various Aspects of the Corporate Average Fuel Economy Program and the Greenhouse Gas Program (June 20, 2016). Attached as Attachment 10.

standards. This approach was based on originally not having included these credits in the CAFE standards, such that credits would only be granted to the extent that manufacturers implemented MAC efficiency technologies faster than EPA assumed when it incorporated these technologies in setting the stringency of its standards.

The Alliance and Global Automakers also requested that NHTSA apply the adjustment factor, beginning in Model Year 2011, when credits are carried forward or carried back within a compliance category, as well as when they are traded and transferred. The adjustment factor in 49 C.F.R. Part 536 was established by NHTSA in response to the Congressional mandate to ensure that when creating a program for trading credits between manufacturers, that overall oil savings remains the same. EPA has a different approach to ensuring the consistency of the benefits in the GHG program. The change requested would help to harmonize the two approaches since the adjustment factor equates the CAFE credit to a linear function similar to the way in which credits are applied in the GHG program.

The Alliance and Global Automakers also requested that NHTSA revise the definition of the term "transfer" in 40 CFR 536.3 to be consistent with language in the 2010 preamble of the proposed rulemaking for 2017-2025 GHG/CAFE standards. This revision would more closely align the NHTSA credit transfer program with that of the EPA GHG provisions as was the expressed intent of the 2010 preamble language.

Alliance and Global Automakers also requested that the Agencies allow manufacturers to manage their credit supply and use. While the manufacturer model year reports track certain credits separately, such as the off-cycle credits, and appear to allow manufacturers the ability to apply either those credits or over-compliance credits as they choose, in a recent publication EPA stated instead that technology credits must be applied before any over-compliance credits are applied. Rather than imposing a priority system on the application of credits, the Alliance and Global Automakers requested that the Agencies allow manufacturers to choose how to apply their available credits.

Appendix H: EPA and NHTSA Treatment of the California Zero Emission Vehicle Regulation

Including ZEV Program Cost

With respect to the ZEV regulations, Section 4.1.4.1 states,

> Because these ZEVs are already required by separate regulations in California and nine other states, these vehicles are built into the EPA reference fleet. This approach reasonably avoids attributing costs to the federal GHG program which necessarily occur due to another existing requirement and assures that those costs are not double counted.[385]

The Alliance agrees that costs should not be double counted, but costs should be counted at least once, particularly since the Draft TAR was developed by the Agency adopting the ZEV regulations (CARB) and the Agency granting a waiver for the ZEV regulations (EPA). Otherwise, the Draft TAR violates the basic tenets of cost-benefit analysis, counting the GHG reductions that result from the ZEV Program as part of the benefit of the federal GHG program, but ignoring the significant associated costs.

In a recent rulemaking, in which CARB was considering reducing the total number of ZEVs from intermediate volume manufacturers, CARB noted:

> The fleet average requirements ensure that air quality benefits do not suffer as a result of an automaker producing fewer ZEVs. Therefore, although the proposed amendments could lead to fewer ZEVs and TZEVs being delivered to California from 2018 to 2025, since the amendments do not modify the in-place fleet average emission standards, the air quality benefits of the ACC [Advanced Clean Car] Program as analyzed in 2011 in the ACC EA [Environmental Assessment] will still be realized.[386]

Of course, CARB is correct – emissions are controlled by very stringent fleet average requirements and the ZEV regulations have no impact on GHG emissions of new vehicles. To the extent that ZEVs are placed in service, they offset other higher emitting vehicles. For example, Tesla Motors produces only electric vehicles that receive GHG credits; according to SEC filings, Tesla Motors sold these GHG credits for almost $200 million.

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[385] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 4-37.

[386] "Initial Statement of Reasons for Rulemaking; Proposed 2014 Amendments to the Zero Emission Vehicle Regulation. State of California Air Resources Board. 2014. 17.

Consequently, the Alliance finds itself in the situation where CARB rightly declares there are no benefits to the ZEV regulations, and the Agencies claim there are no costs while using the ZEV regulations to reduce the cost of the GHG regulation.

Rather than ignoring the costs and counting the benefits, the Agencies should calculate the baseline, reference, and control fleets with the ZEV technology packages available in OMEGA but assume no ZEV regulations are in place. This would determine the number of ZEVs required to meet the GHG regulations absent ZEV regulations. Then the baseline, reference, and control fleets could be recalculated with the ZEV regulations in place. The costs associated with the ZEV regulation can then be properly assigned.

Background

Over the past year, automakers have urged the Agencies to take ZEV Program costs into account during the MTE. EPA has done so, but in a way that violates the basic rules of cost-benefit analysis.

The ZEV Program began in 1990 with CARB's adoption of standards calling for each manufacturer doing business in California to sell 2% ZEVs in 1998, 5% in 2001, and 10% in 2003 within that state. Since 1990, CARB has amended the program several times to account for technical challenges, unexpected costs, and other issues. For example, in 1990 CARB originally estimated that a battery electric vehicle would cost about $1,350 more than a similar gasoline vehicle in 2000.[387] However, 21 years later, in their December 7, 2011 Initial Statement of Reasons (ISOR), CARB projected a battery electric vehicle would cost over $17,000 more than a similar gasoline vehicle in 2016.[388] Currently, the ZEV Program is based on manufacturers generating an increasing number of "ZEV credits." ZEV credits are earned by either selling ZEVs, or purchasing ZEV credits from another manufacturer that has sold excess ZEVs. In the previously mentioned 2011 ISOR, CARB projected that the most likely compliance scenario automakers would pursue would result in 15.4%ZEVs in 2025. Pursuant to §177 of the Clean Air Act, nine other states have adopted the ZEV program.

When calculating the costs of implementing the MY2022-25 GHG standards, EPA builds into its reference fleet--and thereby excludes from its own program the costs of the 280,300 fully electric, plug-in hybrid, and hydrogen fuel-cell electric vehicles that manufacturers are expected to produce in 2021 alone to comply with the ZEV Program. In doing so, EPA acknowledges that it is departing from its own prior cost-benefit accounting practices, but explains that the ZEV

[387] "Initial statement of proposed rulemaking for low-emission vehicles and clean fuels." State of California, Air Resources Board. 1990. 63.

[388] "Initial Statement of Reasons, 2012 Proposed Amendments to the California Zero Emission Vehicle Program Regulations." State of California, Air Resources Board. December 7, 2011. 60.

Program was not in the baseline for the 2012 federal GHG rulemaking because the ZEV Program was under revision and because EPA had not yet acted on CARB's waiver request.[389]

Costs and Breadth of the ZEV Requirements Under the Combined Programs

In considering the ZEV Program and the federal GHG program, cer tain things are apparent. The first is that these programs place unprecedented additional costs on manufacturers and customers. Here are just a few facts illustrating the unpreced ented breadth and costs of these programs:

1. Economists working for ARB estimate that the vehicles manufactu rers must produce to meet the ZEV Program requirements will cost customers between $ 7,500 and $15,000 more in MY2025, as compared to today's average vehicle prices.[390]

2. They also estimate that, by MY2025, compliance with the ZEV Pro gram in California alone will cost automobile manufacturers more than $6 billion annually.[391]

3. The Draft TAR shows BEV200 incremental cost in excess of $16,00 0 in MY2021, and $14,000 in MY2025. Likewise, the PHEV40 incremental costs exce ed $10,000 for the MY2021 to MY2025 timeframe.

4. Collectively, the ZEV states now represent 30% of new light-duty vehicle sales.[392]

5. EPA's analysis in the Draft TAR shows that manufacturers will n eed to sell an additional 220,057 ZEVs to meet the MY2021 federal GHG standards; by MY202 5, this rises to 419,308 vehicles.[393]

6. Finally, the costs above are lik ely conservative, since these c osts are incremental to a gasoline vehicle; that is, they assume that the ZEV and the gas oline vehicle can be sold at the same price. To the extent the transaction price of a ZEV is lower than the comparable gasoline vehicle, the costs of the program rise further. Curre ntly, because of substantial automaker, federal, state, and local incentives, the transactio n price of ZEVs is far below

[389] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 4-37.
[390] "Initial Statement of Reasons, 2012 Proposed Amendments to the California Zero Emission Vehicle Program Regulations." State of California, Air Resources Board. December 7, 2011. 64.
[391] *Id.* at Table 5.6.
[392] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 4-43.
[393] *Id.* at 4-38, 4-39, Tables 4.25, 4.26, 4.27, 4.28.

> that of comparable gasoline vehicles–in fact, in some parts of California, customers are paid to take a 3-year lease for certain ZEV models. In most parts of California, ZEVs are available for well below $100 per month for a 3-year lease. Moreover, as noted in the Draft TAR, manufacturers will begin to exhaust the Federal Tax Incentive (up to $7,500) as early as 2017 or 2018, placing an additional burden on those manufacturers.

California's regulatory process only requires CARB to consider the costs incurred by California business and enterprises.[394] In fact, none of the manufacturers currently subject to the ZEV regulations are based in California.[395] Other states desiring the ZEV Program are required to adopt standards identical to California's, and therefore do not have the option of adjusting the program to reflect economic impacts in or outside of their own states. If EPA now fails to account for the ZEV Program costs, this would mean *there is no point at which state or federal regulators fully consider these costs.*

The ZEV and GHG Programs Are Interwoven

Although the ZEV Program began as a way to address criteria pollutants, the primary reason for CARB's post-2017 ramp-up of the ZEV Program is the state's desire to meet its future GHG reduction goals (40% below 1990 levels by 2030 and 80% below 1990 levels by 2050).[396] This means that both the ZEV Program and the federal GHG requirements are now designed to address the same issue.

In a recent review of the CAFE, GHG and ZEV programs, researchers at Indiana University concluded:

> [T]the potential interactions between the federal and ZEV programs need to be analyzed because the presence of the ZEV program can have major implications for manufacturer compliance strategies, federal credit-trading markets, and attainment of environmental benefits.[397]

Cost-Related Issues That Need to Be Revisited

Use of Credits

Compliance costs with the ZEV regulation should assume that each manufacturer fully complies with the regulations. Purchasing ZEV credits can provide flexibility or cover short-term deficits.

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[394] California Government Code Sections 11346.3 and 11346.5.

[395] "Initial Statement of Reasons, 2012 Proposed Amendments to the California Zero Emission Vehicle Program Regulations." State of California, Air Resources Board. December 7, 2011. 55.

[396] "California's ZEV Regulation for 2018 and Subsequent Model Years." State of California Air Resources Board. Accessed September 26, 2016. http://www.arb.ca.gov/msprog/zevprog/zevtutorial/zev_tutorial_webcast.pdf.

[397] 243. Carley et al, "Rethinking Auto Fuel Economy Policy: Technical and Policy Suggestions for the 2016-17 Midterm Reviews," Phase 1 Report, 4, (Feb. 2016).

However, an automaker adopting ZEV credit purchases as a long-term compliance strategy will quickly find itself funding competitors' technology advances while falling further behind in technology development. Also, as the Agencies have predicted that all manufacturers will need to produce zero emission products to meet the MY2025 standards,[398] it is likely automakers will attempt to comply with regulations by developing technology and vehicles.

Inconsistent Estimates of ZEV Vehicle Needs

Another troubling aspect of EPA's analysis is the lack of clarity about the ZEV volume required to meet the ZEV regulations and the volume required to meet the GHG regulations. In Section 12.1.1.3.2, the Draft TAR states, "[t]herefore, some of the EV and PHEV penetration in the following tables is ZEV program-related (2.6% of the combined fleet), some is in EPA's purchased fleet projections (1.2% of the combined fleet), and some is generated by OMEGA to reach compliance (an additional 0.5% of the combined fleet for a total of 4.3%in the AEO2015 reference fuel price and ICM case)." Presumably, "ZEV program-related" refers to ZEVs that are required only because of the ZEV regulations. However, the Agencies should clarify what is meant by "EPA's purchased fleet projections" as distinguished from "ZEVs required by OMEGA to reach compliance."

Program Changeability

Building the ZEV Program vehicles into the baseline and reference fleets ignores potential changes in the ZEV Program requirements and the fluidity of California's regulatory process. As adopted by CARB in 1990, the original ZEV Program set a deadline of 2003 for manufacturers to meet a 10% ZEV sales requirement.[399] Since 1990, however, CARB has made five major changes to the regulations to better reflect technology, costs, and market conditions.[400] CARB's regulatory process allows for major program changes to be implemented much more quickly than EPA's. Any future adjustments, however, could have national implications for future manufacturer compliance planning. Recently, for instance, CARB's Board asked its staff to consider what program revisions would be needed to assure that 1.5 million ZEVs are sold in California by 2025.[401]

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[398] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 12-20, Tables 12.21 and 12.22.

[399] Zero-Emission Vehicle Legal and Regulatory Activities and Background. State of California Air Resources Board. Accessed September 26, 2016. https://www.arb.ca.gov/msprog/zevprog/zevregs/zevregs.htm.

[400] *Id.*

[401] "Meeting; State of California Air Resources Board." July 21, 2016. Board Member Gioia p. 196, lines 8-13; Board Member Sherriffs p. 197, lines 16-20. Accessed September 26, 2016. https://www.arb.ca.gov/board/mt/2016/mt072116.pdf.

Recommendations

Now that EPA has made the ZEV Program mandates a key part of the ONP, the cost and feasibility of this separate program must be considered as a part of the MTE.

The Agencies should also develop and present costs based on different compliance paths, assuming the ZEV regulations do not exist and in full compliance with the ZEV regulations. The Agencies should include a detailed analysis of the cost of the ZEV Program as it stands today, and if it changes, as a part of the MTE for public comment. Moreover, the Agencies should consider the current transaction prices, likely changes in those transaction prices based on customer acceptance of the technology, and how these changes impact the costs of the regulations.

Going forward, ZEV Program changes must occur in conjunction with the proposed determination and NPRM, as the Agencies have now (appropriately) tied these two programs together.

Appendix I: Alternative Fuel Infrastructure

EPA assumes ZEV mandate levels of electrification within its modeling of the 2021 reference and control fleets. In addition, the Alliance believes a much greater degree of advanced technology is likely required for compliance with the MY2022-2025 standards than modeled by the Agencies in the Draft TAR, at least a portion of which may require additional alternative fuel infrastructure. Therefore, consideration of the status of alternative fuel infrastructure systems is warranted. The Agencies have provided their assessment in Chapter 9 of the Draft TAR.

The Alternative Fuel Infrastructure Assessment is Inadequate and Incorrect

As part of the MTE, the Agencies prepared an assessment of the state of the Alternative Fuel Infrastructure as an indicator of the viability of electric and fuel cell vehicles in the marketplace.[402] The assessment relied on three key initial assumptions: 1) the requirements can be met with only a small percentage of electric vehicles (EV); 2) infrastructure and vehicle requirements are evenly distributed; and, 3) today's customers and vehicles will not change. These assumptions are flawed, over-simplified, and lead to incorrect conclusions about the sufficiency of and the need for infrastructure.

In fact, the Draft TAR does not contain any assessment of the infrastructure needs based on the location of current PEVs or the location of PEVs required by states that have adopted the ZEV regulations. Instead, the Agencies simply assume that all PEVs and all charge points are appropriately distributed throughout the country. The Draft TAR ignores media reports on the scarcity of charging in California, [403] the largest ZEV market in the U.S., and the significant increase in ZEVs required by the ZEV regulations in the 2018 to 2025 timeframe. Moreover, the Draft TAR does not consider the vital role that infrastructure plays in accelerating customer acceptance of PEVs in the market place to increase their appeal to an expanded mainstream customer base.

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[402] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 9-15 et seq.

[403] *See* for example, "In California, Electric Cars Outpace Plugs, and Sparks Fly. *The New York Times.* October 10, 2015. Retrieved from http://www.nytimes.com.

Level 1 Charging will not be a long term solution:

The Draft TAR suggests that the majority of charging can be accomplished using a Level 1 (120V) solution provided by the automotive manufacturer with the vehicle.[404] The Alliance agrees that today the primary charging location for EV is at home and that many customers use the manufacturer-provided Level 1 charge cord. However, several auto manufacturers have already announced increased ranges for both BEV and PHEV making Level 1 charging irrelevant due to longer charge times reducing the suitability of overnight charging using the Level 1 cord. As noted by the Agencies, the practicality of Level 1 reduced in light of larger battery capacity and vehicle range.[405]

The Draft TAR ignores the fact that to sustain sales of EVs, customers need to see an EV as a viable alternative with transparent functionality compared to the traditional ICE vehicle. The ICE vehicle owner generally has a range of over 300 miles and refills in a short period of time as needed at a gas station that can be paid for using the same method at all locations and can be used on daily commutes as well as longer destination travel. BEVs, on the other hand, require substantial charging time even with Level 2 charging, making home, workplace, and public charging essential for mainstream customers.

Finally, with regard to cost, the Draft TAR assumes little additional expense for home charging infrastructure, citing a large portion of charging needs are currently being met by existing access to a standard 120V outlet.

> Most, if not all, OEMs provide a Level 1 cord set at no additional charge with each sale or lease of a PEV. Since the cost of the Level 1 cord set is factored into the price of the vehicle, there is no additional out-of-pocket expense to the consumer opting to use this option to charge their vehicle.[406]

However, not every garage or driveway has access to 120V charging, particularly in older neighborhoods. And, as the Draft TAR pointed out, 36% of residences do not have dedicated parking and require an alternate charging solution.[407]

Further, as mentioned above, increased volume of longer range electrified products will increase the need for Level 2 solutions to maintain overnight charging, which typically carry installation costs in the range of $2,000. National building codes requiring conduit and panel capacity for new construction or significant renovations and/or to require station installation will help to

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[404] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 9-3
[405] *Id.* at 9-4.
[406] *Id.* at 9-3.
[407] *Id.* at 9-20.

reduce future installation costs and assist with customer acceptance by reducing installation challenges, but these enablers are not widely in place.

DC Charging allows EVs to be utilized as a conventional ICE vehicle:

The statement that the more expensive direct current (DC) infrastructure is used for the fewest charging events[408] is based on current usage and minimizes the importance of DC charging for future customer acceptance. A growing number of vehicles are equipped with DC capabilities as vehicle range and DC station installations increase, which will result in increased station utilization. DC stations allow for increased vehicle utilization which could allow for customers to replace their ICE vehicles with EV thereby increasing vehicle sales opportunities. DC may also be a required enabler for multi-unit dwellings (MUDs).

Insufficent Charging Infrastructure to Support Future Growth:

As discussed above, significant growth in electrified products will be required to meet future ZEV regulations. The majority of sales today is concentrated in those regions which mandate sale of electrified products, and have provided significant market support (infrastructure, incentives, etc.) to encourage their sale. However, broader penetration to the mainstream customer will be required to meet future higher sales.

The Draft TAR references the NREL study conducted on behalf of the California Energy Commission (CEC), noting "NREL calculated that the minimum ratio of non-home based charge points (both workplace and public) to PEVs is 0.14 charge points per PEV in the home dominate scenario and 0.24 in the high public access scenario."[409] However, the current EV infrastructure is not sufficient to support even the current number of PEVs when the distribution of PEVs is considered.

Further, the Agencies need to consider, per the discussion above, the need for charging to accommodate products with longer EV range, and for customers in MUDs and residences without dedicated parking.

Table 9-1 shows the PEV population and charge points as of September 11, 2016 in the states that have adopted ZEV regulations.

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[408] *Id.* at 9-77.
[409] *Id.* at 9-24.

Table 9-1: Plug-in Vehicle Population by State and Ratio of Plug-In Vehicles to Charge Points[410,411]

State	BEV Population*	PHEV Population*	Total PEV	Actual Charge Points**	Ratio BEV Only	Ratio All PEV
CA	110,599	105,322	215,921	10,478	0.09	0.05
CT	1,592	2,758	4,350	510	0.32	0.12
MA	2,857	4,558	7,415	1,116	0.39	0.15
MD	2,470	4,529	6,999	972	0.39	0.14
ME	191	852	1,043	150	0.79	0.14
NJ	3,354	6,127	9,481	431	0.13	0.05
NY	4,571	12,462	17,033	1,427	0.31	0.08
OR	5,829	3,655	9,484	1,091	0.19	0.12
RI	203	540	743	195	0.96	0.26
VT	275	1,068	1,343	334	1.21	0.25
Total	131,941	141,871	273,812	16,704	0.13	0.06

The Agencies make a couple of assumptions that warrant more con sideration, as discussed below.

BEV Only

The Draft TAR proposes that

> [i]ntuitively, it is less likely that PHEV adoption rates are a s dependent upon robust EV infrastructure as BEVs. Given this important distinct ion, the question of infrastructure sufficiency will be addressed for BEVs by exa mining a snapshot

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[410] BEV, PHEV population based on data from IHS Automotive (January, 2011 through May, 2016).

[411] Actual charge points from Department of Energy Alternative Fue ls Data Center. Accessed September 11, 2016. http://www.afdc.energy.gov/fuels/electricity_locations.html.

of current BEV numbers in relationship to the EV landscape and trends, and comparing that relationship to work performed by NREL for the CEC.[412]

The Alliance agrees that PHEV adoption will be less impacted by the current and future lack of adequate infrastructure. However, considering only BEVs when looking at PEV infrastructure ignores that PHEVs do use the infrastructure and potentially displace BEVs. The Alliance knows of no public or workplace chargers currently prohibit charging by PHEVs. Thus, the analysis must include all PEVs, since all PEVs will use the infrastructure regardless of need.

Moreover, limiting the analysis to BEVs ignores the longer range PHEVs coming to market, their need for Level 2 workplace and public charging, and the environmental benefit associated with operating those on electricity. For example, the 2017 Chevrolet Volt has a 53 mile all-electric range, but requires between 12 and 19 hours for a full charge using Level 1 charging. The Chrysler Pacifica Hybrid has a similar-sized battery. Level 1 charging might not be sufficient for high mileage drivers, and would certainly prevent substantial grid benefits associated with charging during off-peak hours. Consequently, to maximize the benefit to both society and the driver, workplace and public level 2 charging is needed. The Draft TAR analysis ignores these points.

Home Dominate Scenario

The Draft TAR selects the home dominate scenario ratio of 0.14, citing "[s]tudies have shown that, on average, over 80% of all charging events occur at home."[413] However, the relationship between the number of charging events at home and public charging is not clear. That is, do over 80% of all charging events occur at home because of a lack of public infrastructure? Would 80% of all charging events occur at home if sufficient public charging existed? As noted in Table 9-1, the ratio of PEVs to charge points is far below the minimum number determined by NREL. In determining the number of charge points needed, the Agencies should, at a minimum, select a mid-point between the home dominate and public dominate (i.e., 0.19). Regardless, the current number of public charge points is insufficient by any measure.

It is also premature to simply assume that infrastructure will expand sufficiently on its own. At this point, it is difficult (if not impossible) to recoup the high costs associated with installing public infrastructure, even with federal, state, and local incentives.[414]

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[412] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 9-24.
[413] *Id.* at 9-24.
[414] "Financial Viability of Non-Residential Electric Vehicle Charging Stations." Luskin Center for Innovation, School of Management, University of California Los Angeles. 2012. Accessed September 26, 2016. http://luskin.ucla.edu/sites/default/files/Non-Residential%20Charging%20Stations.pdf.

Finally, it is not sufficient to develop the infrastructure "as needed." Range anxiety and customer awareness inhibit mainstream customer acceptance of ZEVs. Infrastructure installation must lead vehicle sales to raise customer awareness, address range anxiety, and demonstrate infrastructure is available to support customer needs.

Solutions for customers with non-designated parking are required to address a significant portion of the population

The Draft TAR rightly identifies MUDs as a challenge because of the variety of solutions required to address the multitude of possibilities associated with this type of housing.[415] Also, since a significant portion of the population (36% per the Draft TAR) living under these conditions, solutions are needed to support the continued market growth.[416] In the unlikely event that Level 1 charging is a viable option at MUDs, it may not meet the customers' charging needs, especially if overnight charging is not be possible. MUDs frequently do not have dedicated parking.

Wireless/Inductive Charging and VGI

The Draft TAR also suggests that wireless/inductive charging may be a challenge as well as an opportunity. However, the Draft TAR does not recognize that wireless standards have only recently been published by SAE at the TIR level (draft form for first level comments) and that interoperability is not addressed by the requirement meaning that systems cannot yet be used interchangeably, thus limiting installation to residential installations only.[417] There are also concerns with system power levels and electromagnetic frequency (EMF) exposure that have yet to be resolved. In addition, system pricing is significantly greater than conductive systems with similar installation costs, making the package unattractive to many customers.

The Draft TAR discusses the opportunity of vehicle-to-grid interface (VGI) but does not recognize the changes required by both the infrastructure and the vehicle which have yet to be implemented, and the challenge of developing a business case to support implementation. Further, VGI assumes that all stations and vehicles are able to communicate with the grid and/or utility, vehicles are connected to the grid, and that vehicle batteries are not negatively affected by the additional charge/discharge sequences. The Status of the Infrastructure Network suggests that these challenges "are systematically being addressed and infrastructure is progressing

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[415] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 9-25.
[416] *Id.* at 9-25.
[417] "Wireless Power Transfer for Light-Duty Plug-In/ Electric Vehicles and Alignment Methodology." SAE Internation. SAE TIR J2954. Accessed September 26, 2016. http://standards.sae.org/wip/j2954/.

sufficiently to support the scale of the EV market projected in the Draft TAR...[418] However, the Draft TAR provides nothing to substantiate this conclusion.

Infrastructure Permitting and Cost

Local permitting procedures and building codes can serve as significant barriers to the commercialization of PHEVs and EVs. For example, existing building infrastructure may not have proper electrical service (i.e., service amp rating) to accommodate charging. Multi-unit dwellings and older homes are particularly problematic since they can require substantial retrofitting (e.g. tearing up of asphalt) to install charging stations. In addition, if the transformers that feed the building are not sufficient to handle the electricity volume, this must be upgraded at considerable expense. Further, there may be disagreements where home owner associations or condo associations are unable to accommodate the expensive retrofits, or those who do not drive PEVs are unwilling to approve budget and essentially subsidize those who do.

In addition, in high density areas like inner cities, land and parking is highly valued and the profit margins for turning space into publicly available charging stations are so low that there is no payback or it actually creates a decrease in value (e.g. if the charging station revenue doesn't cover property taxes.) If local, state, and federal governments depend on the infrastructure to be placed on private property, there must be sufficient value for this to be a sustainable business. This situation is made more difficult since charging stations in many cases must be compliant with the Americans with Disabilities Act (ADA) requiring more than one space per charger.

Refueling Costs for PEVs

The analysis of costs to customers for charging should be addressed in detail by the Agencies. In many of the states that have adopted ZEV regulations, the cost of electricity (both at home and especially at pay public charging stations) to charge PEVs could greatly exceed the operating cost of a similar gasoline vehicle.

Looking only at the public charging stations, the rates charged for use at some stations can be four times as high as residential power rates making the costs to operate the PEV substantially higher than operating a similar gasoline vehicle. For example, the Blink Network, which has over 1,200 stations nationwide, charges $0.49/kWh in San Diego– more than twice the cost of operating a similar sized gasoline vehicle. [419] Further, some companies charge a per-session fee for charging which varies dependent on the rate of charging. AeroVironment, for instance, charges $7.50 for fast charging per-session, or $4.00 per session for Level 2 charging. Rates also

[418] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 9-25.

[419] "Frequently Asked Questions." Blink. Accessed September 26, 2016. http://www.blinknetwork.com/membership-faqs.html

vary among independently owned stations. This rate variation can provide uncertainly for customers.

Many public charging stations also charge a "post occupancy fee" for leaving a fully charged car plugged in, which can be as much as $0.08/minute and can quickly increase the variable cost of this technology, and certainly increases the required customer oversight and interaction.[420] The bottom line is that there is much more to the payback equation for customers than a simple home charging rate analysis can provide. The Agencies should provide a thorough analysis as a part of both the ZEV costs and the GHG/CAFE program to fully inform customers.

Hydrogen Infrastructure

The hydrogen infrastructure, as with the EV infrastructure, needs to be installed in advance of vehicle sales to demonstrate that customers have an ability to fuel the vehicle. Although hydrogen-powered vehicles have longer ranges than current electric vehicles, the infrastructure installation lags considerably, suggesting that hydrogen sales will be limited without significant support. Toyota Mirai vehicle deliveries were delayed because planned installations in California were not completed as expected. Installations are expensive and limited vehicle sales challenge the business case.

Summary

The Draft TAR oversimplifies the infrastructure assessment and does not support the conclusion that installations will continue in advance and at a rate to support continued, accelerated vehicle sales. The conclusions are not valid for today's customers and vehicles and may not hold true for future customers and vehicles, particularly taking into account the announcements already made by automakers on future product capabilities or requirements.

[420] "Blink Implements Post-Charging Occupancy Fee At Charging Stations" *Inside EVs*. July 2015. Accessed September 26, 2016. http://insideevs.com/blink-implements-post-charging-occupancy-fee-charging-stations/. And "Blink Network Gets Tough on Electric Car Charging Station Hogs, Introduces Post-Charging Occupancy Fee." Transport Evolved. July 13, 2015. Accessed September 26, 2016. https://transportevolved.com/2015/07/13/blink-network-gets-tough-on-electric-car-charging-station-hogs-introduces-post-charging-occupancy-fee/.

Appendix J: Safety Analysis

NHTSA has generated a new dataset of more recent vehicles (MY2003-2010) using the Fatality Analysis Reporting System (FARS) (CY2005-2011). This dataset was released to the public in June 2016 and has been used in the Draft TAR to study various mass reduction scenarios and their effect on safety. This is the first update of safety related to mass and size distribution of the fleet of light vehicles since 2012. Given the short time for comments, it is not possible to conduct an independent analysis of the new dataset. Instead, we have evaluated the Draft TAR at a high level. We find inconsistencies in the conclusions that require further physical explanations.

Using two highly correlated factors, mass and size of vehicles, in a regression analysis can lead to unreliable and non-physical results. Some obvious examples show up in the coefficients for "hit fixed objects" and two vehicle collisions with heavy trucks in the baseline model (Table 3-7 of the 2016 Preliminary Relationship between Fatality Risk, Mass and Footprint 2003-2010 Volpe Report). For example, the regression analysis shows that a 100 lb. reduction in weight of heavier, truck-based LTV (>4947 lbs.) will result in an increase of fatality risk by 1.79% in crashes against fixed objects, but such a weight reduction in cars and other LTVs will reduce the risk in cars and other LTVs. In the case of CUVs and Minivans, the reduction is as much as 3.12% for these vehicles when involved in fixed object collisions. This finding is contrary to NHTSA's past studies, and studies elsewhere in the literature. Another example of inconsistent results is in crashes against heavy vehicles (>10,000 GVWR). The coefficients indicate that reducing the weight of a truck-based LTV (<4947 lbs.) by 100 lbs. will increase the fatality risk by 3.85%, but reducing the weight of a car (<3197 lbs. Curb weight) by 100 lbs. will increase the fatality risk by only 2.57% in collisions against heavy vehicles (see Table 3-7 of 2016 Volpe report). Higher increases in fatality risks in the lighter cars and LTVs are expected.

The Alliance also finds inconsistencies in the results between the 2016 Volpe Report (Table 3-7) and Table 8.7 of the Draft TAR. Both address the 100 lbs. reduction of the entire fleet of light vehicles. The estimated increase reported by Volpe is 91, but the increase in the Draft TAR is 55. No explanation for the difference between the two estimates is proffered.

Table 8.7 in the Draft TAR shows the estimated annual change in fatalities from six different fleet wide mass reduction scenarios. It is obvious that the three different estimates (2012 NHTSA baseline, 2016 NHTSA baseline, and the 2016 DRI measures) do not agree in their effects or actual numbers. For example, the 2012 NHTSA scenario 6 (NRC-suggested weight reduction of the fleet) indicates an increase of 224 annual fatalities; the 2016 NHTSA baseline indicates a reduction of 220 annual fatalities; and the 2016 DRI measures indicates an annual reduction of 1306 fatalities. Such differences in projections require further studies to explain the results.

With the current conflicting results from statistical modeling, it is advisable to pursue a standard, and underlying technology pathways , that are safety neutral. T his includes being judicious in weight reduction of LTVs.

Appendix K: Miscellaneous Issues

Comment Period and Schedule for Completing the MTE

TAR Comment Period Extension Request

The Draft TAR spans more than 1,200 pages and incorporates the findings of dozens of separate studies, many of which were not previously available for public comment. The Alliance is still evaluating the Draft TAR and identifying data upon which the Agencies relied to run the five models (ALPHA, LPM, OMEGA, Autonomie and the Volpe model) that serve as the basis for the MTE, and to understand how the data was used. On August 1, 2016, the Alliance submitted a request for an extension of the 60-day comment period, which was subsequently denied by the Agencies.[421]

The Comment Period Specified for the Draft TAR Should Not Preclude Additional Technical Comments on the Proposed Determination and/or NPRM

For the reasons explained in the Alliance's August 1, 2016,[422] request for an extension of time to comment on the Draft TAR, the Alliance asserts that 60 days was not sufficient time to review and provide full input on all of the complex technical analyses in the Draft TAR. As expressed previously, the Alliance anticipates that the Agencies will respond formally to comments that may need to be submitted after the close of the 60-day comment period, and expects that the Agencies will do so prior to issuing a proposed decision and NPRM to ensure that the next steps of the MTE include the most up-to-date information.[423]

Moreover, it is important to clarify the legal effect of the comment period on the Draft TAR. The Draft TAR is not a decision document and thus is not "Agency action" or a "proposed rule" within the meaning of the Clean Air Act (CAA) or the Administrative Procedure Act (APA), because it is intended only to inform the MTE, and does not itself have or propose to have legal consequences.[424] The Agencies' proposed actions (whether a proposed determination or NPRM), on the other hand, are formal rulemakings and thus must be accompanied by, among other things, a statement of the rule's basis and the factual data and methodology relied upon. As such, irrespective of any deadline to comment on the Draft TAR, the public must have an

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[421] Docket ID EPA-HQ-OAR-2015-0827-0928.

[422] *Id.*

[423] Docket ID EPA-HQ-OAR-2015-0827-3292.

[424] *See* 5 U.S.C. § 551(4) (defining "rule" to mean "the whole or a part of an Agency statement of general or particular applicability and future effect designed to implement, interpret, or prescribe law or policy or describing the organization, procedure, or practice requirements of an Agency . . ."), § 551(13) (defining "Agency action" to include "the whole or a part of an Agency rule, order, license, sanction, relief, or the equivalent or denial thereof, or failure to act").

opportunity to comment fully on the Agencies' proposed decisions. To the extent that EPA or NHTSA relies on any aspect of the Draft TAR in their proposed actions, the Agencies must take comment on those issues during the post-proposal comment period, and must address all such comments in their final determination and/or final rulemaking.[425] Likewise, to the extent that the Agencies rely on revised conclusions from the Draft TAR (taking into account input on the Draft TAR or other subsequent developments) in their proposed determination and/or rule, the basis for those revised conclusions similarly would be subject to public comment. In other words, the comment period on the Draft TAR must be in addition to, and not to the exclusion of, an opportunity to comment on the proposed decisions, including the basis for those decisions, at a later stage. Based on the Agencies' June 10, 2016 letter to the Hon. Ed Whitfield, the Alliance trusts that the Agencies agree with this analysis.

Analysis of Letter Denying Extension

In the letter denying the Alliance and Global Automaker's extension request,[426] the Agencies note that the both the EPA and NTHSA websites have provided information for more than 18 months. Although the websites contained some referenced data studies, the over 1,200 pages of the Draft TAR and much of the modeling was not released before the comment period. Additionally, since a primary component of commenting on a document is understanding how cited references are applied, simply posting references is of little help in the review and comment process.

The denial letter also notes that EPA has published more than 25 peer reviewed papers that stakeholders could have reviewed, that the Agencies have presented at several technical conferences to keep stakeholders informed of the Agency work, and that the Agencies held a public modeling workshop in March 2016.[427]

Peer review, though valuable, is not the same thing as public review and comment. Most of the EPA technical papers and studies were published through the Society of Automotive Engineers (SAE), whose peer review process consists of SAE members who self-identify as qualified peer reviewers. Except for a few questions being allowed in technical conferences and at the single modeling workshop, there was no opportunity for dialogue with the Agencies. With the exception of the March 2016 workshop,[428] the conferences referred to were not free.

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[425] *See* 42 U.S.C. 7607(d)(6)(B) (requiring the promulgated rule to "be accompanied by a response to each of the significant comments, criticisms, and new data submitted in written or oral presentations during the comment period"); 5 U.S.C. § 553 (requiring Agencies to give "interested persons an opportunity to participate in the rule making through submission of written data, views, or arguments" and to consider the "relevant matter presented").
[426] Docket ID EPA-HQ-OAR-2015-0827-1129.
[427] *Id.*
[428] "NHTSA, EPA and CARB workshop on technology effectiveness modeling methodologies for the midterm evaluation draft technical assessment report (TAR) analysis for CAFE standards and GHG standards." National

Before the Draft TAR was released, the EPA did not release model input/output files or the updated OMEGA, ALPHA, or lumped parameter models. Even where individual manufacturers provided data to test the models, the Agencies did not share their results. Also, notably, there were not any public workshops on other key issues such as customer acceptance, impact on employment or impact on the U.S. economy.

Over the last two years, the Alliance has made a good faith effort to express its concerns and questions about Agency methodology and assumptions (technology, customer acceptance, modeling, etc.), to support the Agencies with detailed information to help resolve uncertainties. The Alliance is now being afforded only 60 days to digest how the Agencies have responded to two years of resource-intensive industry input to the Draft TAR.

Finally, EPA has only recently publicized significant changes in its consideration of cost and effectiveness of key technologies in the Draft TAR (e.g. dropping GTDI penetration significantly, adding mild hybrids and advanced Atkinson engines).

Although our request for a longer comment period has not been granted, Agency management has indicated that comments received after September 26, 2016 will be considered. The Alliance may submit supplemental attachments to our comments as the information becomes available to complete our own analyses. As stated in our letter responding to the Agencies' denial letter, we expect the TAR comments, including the comments submitted after the September 26, 2016 deadline, will be taken into consideration in next steps of the MTE.

The Agencies Should Clarify Their Anticipated Schedule for Completing the MTE and Coordinating with CARB

The Alliance believes that it would be helpful to all stakeholders for the Agencies to explain their current anticipated schedule for completing the MTE process following issuance of the Draft TAR. The Alliance recognizes that EPA declined in the 2012 FRM to commit to a specific schedule beyond those items identified above.[429] Nevertheless, the Alliance believes that the Agencies should explain their current intentions regarding: (1) whether (and if so, when) the Agencies intend to issue a Final TAR; (2) when the Agencies expect to issue a proposed determination and/or NPRM; (3) the specific timing of the joint final rule if EPA determines that the MY2022-2025 are not appropriate; and (4) the Agencies' own schedule for further consideration of particular technical topics. In this manner, stakeholders may best prioritize their own resources to provide timely input that is most helpful to the Agencies' decision-making.

Highway Traffic Safety Administration. Accessed September 26, 2016.
http://www.nhtsa.gov/Laws+&+Regulations/CAFE+-+Fuel+Economy/nhtsa-epa-carb-workshop-03012016.
[429] 77 Fed. Reg. 62624, 62787 (Oct. 15, 2012).

Finally, the Alliance notes that CARB is a joint issuer of the Draft TAR and is pursuing its own midterm evaluation. EPA and NHTSA should seek to be transparent in their coordination with CARB, and should ensure that the midterm evaluations being performed by the federal Agencies and CARB are aligned, particularly in regard to the schedule for their respective actions. Plainly, where complicated technical issues are the subject of ongoing analyses that may evolve with new information on a continuous basis, it makes sense for EPA, NHTSA and CARB to consider that information consistently and at the same time. Otherwise, unwarranted inconsistencies may arise due to differences in the factual or informational basis for the decisions.

Draft TAR Comments on VMT Calculations

In Section 13.1.4 of the Draft TAR, [430] NHTSA discusses a new method of determining VMT. While the previous method was based on data from National Household Travel Surveys (NHTS), the proposed method is based on a purchased data set of odometer readings from IHS/Polk.[431]

The new method yielded approximately 20% lower survival weighted, lifetime VMTs for most light-duty vehicles (Table 13.1). This is a significant reduction that requires greater explanation and understanding before any action is taken. Of great concern for manufacturers is the fact that VMTs affect the adjustment factors used in credit trades and transfers.[432] Any changes in VMT calculation methodology will affect the value of credits already earned or expected to be earned from future product plans.

We also note that EPA uses VMT in its calculation of GHG credits.[433] Since vehicles simultaneously consume fuel and emit CO_2, we believe it is only logical that both Agencies use the same VMT in their calculations. For stability and harmonization in the GHG and CAFE programs, we believe that future VMT should remain at the present levels of 195,264 for passenger cars and 225,865 for light-duty trucks.[434]

MOVES Modeling

The Alliance recommends that EPA investigate updates to the Motor Vehicle Emission Simulator (MOVES) model [435] deceleration / coasting bins to more accurately reflect on-road activity data. Currently the MOVES model lumps all coasting, mild braking, and aggressive braking activity data into one bin. Given the emergence of new technologies such as BEVs,

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[430] Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, (EPA-420-D-16-900, July 2016) at 13-11.
[431] *Id.* at 13.-11.
[432] 49 CFR § 536.4.
[433] 40 CFR § 86.1865-12(k)(4).
[434] Id.
[435] "MOVES (Motor Vehicle Emission Simulator)." U.S. Environmental Protection Agency. Accessed September 26, 2016. https://www3.epa.gov/otaq/models/moves/.

HEVs, mild HEVs, alternator regeneration, and rolling stop, the Alliance recommends that EPA consider the addition of three new MOVES vehicle specific power bins to account for future on-road benefits of these types of systems.

Separate Car and Truck Standards

The Alliance continues to support maintaining separate, but comparably stringent, GHG and FE standards for passenger cars and light trucks. Car and trucks have unique attributes that require differing standards.

Consumers Union
POLICY & ACTION FROM CONSUMER REPORTS

September 21, 2016

Environmental Protection Agency (EPA)
National Highway Traffic Safety Administration (NHTSA)
California Air Resources Board (CARB)
Submitted via: www.regulations.gov and
http://www.arb.ca.gov/lispub/comm2/bcsubform.php?listname=drafttar2016-ws

Re: Consumers Union's Comments on Midterm Evaluation Draft Technical Assessment Report for Model Year 2022–2025 Light Duty Vehicle GHG Emissions and CAFE Standards (Docket ID No. EPA–HQ–OAR–2015–0827 and Docket No. NHTSA–2016–0068)

Introduction

Consumers Union[1] ("CU"), submits the following comments to the U.S. Environmental Protection Agency ("EPA"), National Highway Traffic Safety Administration ("NHTSA"), and California Air Resources Board ("CARB"), (collectively "the agencies") in the above-referenced matter. In addition, 31,973 consumers signed a petition in support of strong fuel economy and greenhouse gas standards, which is included in Appendix A.

The transportation sector places a heavy burden on consumers and the environment. In 2015, consumers spent an average of $2,090 on fuel costs and motor oil, even as gas prices remained near their lowest point in a decade.[2] Transportation accounts for over one-quarter of domestic greenhouse gas

[1] Consumers Union is the policy and mobilization arm of Consumer Reports. Consumers Union works for [pro-consumer energy policies,] health reform, food and product safety, financial reform, and other consumer issues in Washington, D.C., the states, and in the marketplace. Consumer Reports is the world's largest independent product-testing organization. Using its more than 50 labs, auto test center, and survey research center, the nonprofit rates thousands of products and services annually. Founded in 1936, Consumer Reports has over 8 million subscribers to its magazine, website, and other publications.
[2] "Consumer Expenditures (Annual) News Release" Bureau of Labor Statistics at http://www.bls.gov/news.release/cesan.htm.

emissions, and light-duty vehicles are by far the biggest emitter in the transportation sector, putting 1,100 million metric tons of greenhouse gases in the atmosphere in 2014.[3] Fortunately, gradual improvements to fuel economy and emission standards are part of a practical and tested program to reduce fuel consumption, improve the vehicle fleet, and save consumers trillions of dollars in fuel costs. Automakers have developed the technology to make better, safer, and more efficient vehicles, and the agencies should push forward in setting and implementing the standards to continue this progress.

Comments

Consumers Support Fuel Economy Standards

In a nationally representative survey conducted in May 2016, Consumers Union found strong majority support for robust fuel economy standards and also found that fuel economy is the number one attribute vehicle owners would like to see improved.[4] Highlights from the survey include:

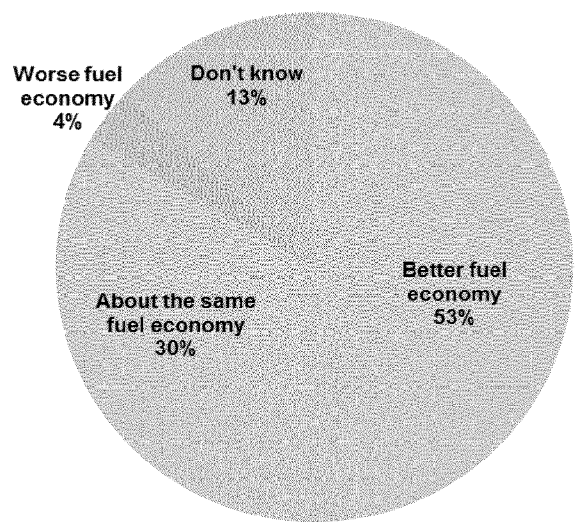
- 76% of American adults agreed that increasing average fuel economy from 25 miles per gallon today to 40 miles per gallon by 2025 is a worthwhile goal.
- 79% of American adults agreed that making larger vehicles, such as SUVs or trucks, more fuel-efficient is important.
- 60% of American adults are willing to pay extra for a more fuel-efficient vehicle if they can recover the additional cost through fuel savings within 5 years.

[3] "Fast Facts U.S. Transportation Sector Greenhouse Gas Emissions 1990-2014," Office of Transportation and Air Quality, EPA-420-F-16-020, published June 2016 at https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100ONBL.pdf.

[4] *See* Appendix B for the full survey report.

- Fuel economy topped the list of attributes that American drivers think have the most room for improvement, beating out: purchase price, connectivity, range, vehicle comfort, passenger room, safety, cargo space, reliability, horsepower, vehicle size, off-road capability, style, and handling.
- The auto brands perceived as the best overall were also those perceived as the best in delivering fuel economy.
- Compared to their current vehicles, over half (53%) of adult American drivers expect better fuel economy with their next car purchase.

Expected change in fuel economy with next vehicle purchase



Fuel Economy Standards Provide a Clear Positive Value for Consumers

1. *Net savings.*

Consumers Union commissioned a study from Synapse Energy Economics to identify the net costs and benefits car buyers are likely to experience once the 2025 standards are in place.[5] This study shows that increased fuel economy with the more stringent 2025 CAFE standards will lead to substantial net savings for both car and truck owners. Under mid-range assumptions, the report estimates

[5] The full report is in Appendix C and can be found here: http://consumersunion.org/wp-content/uploads/2016/09/Fueling-Savings-Consumer-Savings-from-CAFE-2025.pdf.

that the new standard will save $3,200 per car and $4,800 per truck. Assuming the vehicle is purchased using a loan, decreased fuel spending immediately outweighs the compliance costs.[6]

Figure 3: Annual Car Compliance Costs and Fuel Savings (relative to MY 2016, assuming financing)

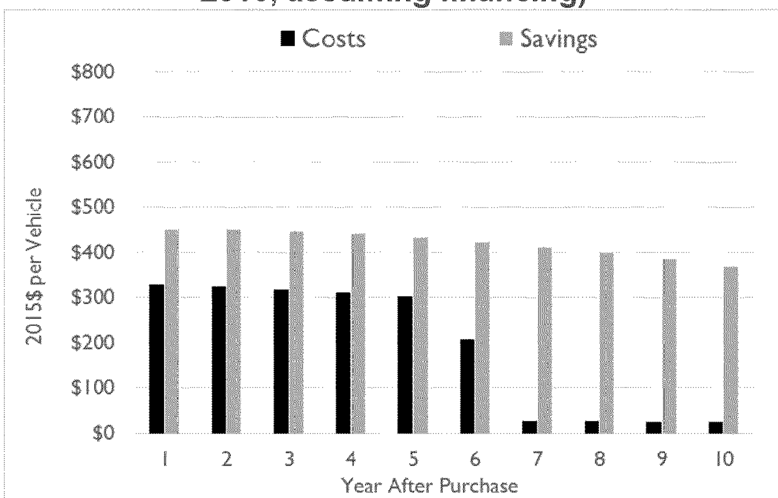
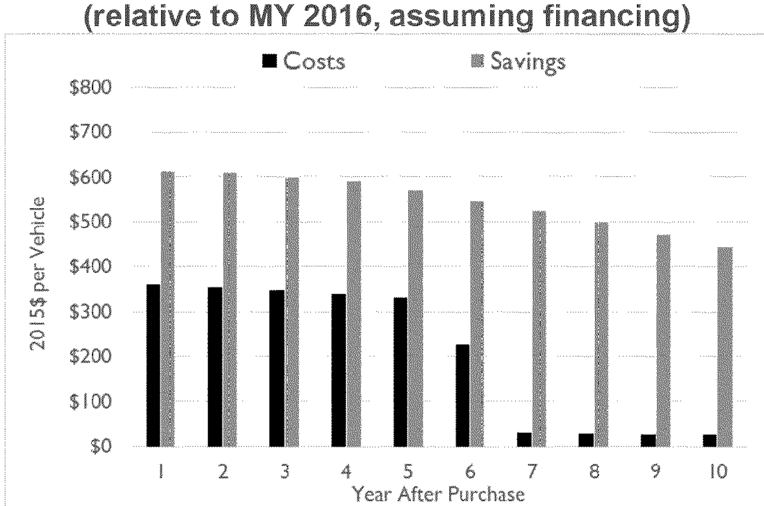


Figure 4: Annual Light Truck Compliance Costs and Fuel Savings (relative to MY 2016, assuming financing)



If a buyer pays cash for the new vehicle, payback for added efficiency technology occurs in 3 to 4 years. These results are based on a gasoline price

[6] Using the average loan term of 68 months and average interest rate of 4.79% based on data from Experian.

forecast of \$3.00–\$3.50 per gallon for the decade beginning in 2025. Under a high gas price (\$5.00–\$5.50) regime, the net savings increase by nearly 80 percent for cars and 70 percent for trucks. In the unlikely case that gas prices decrease from today's prices—and remain low—the net savings would remain positive, but decrease by about half the levels under base case gas prices.

2. *Greater choice and selection.*

A majority of consumers expect their next vehicle to get better fuel economy, even if they expect to buy an SUV.[7] Footprint-based fuel economy standards encourage automakers to design and sell vehicles that have better fuel economy across vehicle size and class. This trend aligns with consumer preferences for better fuel economy in SUVs and trucks. In 2016, there are dozens of SUVs and trucks that get in the mid- to high-20s miles per gallon overall, many of them non-hybrids. In 2006, there were only a handful of SUVs and trucks that broke into the 20s for overall miles per gallon, and most of them *were* hybrids. Vehicle selection, variety of powertrains, and consumer choice will continue to expand as the standards continue to steadily rise.

3. *Insulation from future higher prices.*

Gas prices are notoriously hard to predict, but taking the long view to incrementally improve fuel economy over time provides market stability for automakers and pocketbook security for consumers. By making the investments over a longer time frame, automakers and consumers can avoid more costly

[7] *See* Consumers Union survey, p. 6 in Appendix B.

market shifts that occur more suddenly and without enough time to redesign a new fleet or buy new vehicles when gas price swings occur.

Higher Fuel Economy Is Correlated with Higher Owner Satisfaction

As another measure of consumer interest and benefits from better fuel economy, Consumers Union investigated the relationship between fuel economy and owner satisfaction. The results of the two-part analysis show that when holding other factors constant, higher fuel efficiency is positively associated with higher owner satisfaction in almost all cases.[8]

The first part of the analysis was based on responses to the 2015 Consumer Reports Annual Questionnaire conducted in the spring of 2015; a follow-up survey conducted during summer 2015; and road tests performed by CR's Auto Test Center. The dataset consisted of approximately 1 million records and represents the population of CR subscribers. Though many additional factors determine owner satisfaction, the analysis evaluated the relationship between owner satisfaction and the following vehicle attributes: fuel economy, acceleration, horsepower, mechanical problems, CR's road-test score, and CR's tested price. All six attributes examined in the first analysis show significant association with owner satisfaction for cars and SUVs. Fuel economy was second only to mechanical problems in the strength of the association with higher owner satisfaction.

[8] The full analysis is attached as Appendix D and can be found here: http://consumersunion.org/wp-content/uploads/2016/06/CU-Owner-Satisfaction-MPG-Report.pdf.

The second analysis was based on vehicle-specific owner-reported MPG and therefore, was not affected by differences in vehicle attributes. It also showed a significant relationship between owner satisfaction and increases in fuel economy for all vehicle types.

The dataset for this analysis included vehicles from model years 2012-2015 and so it includes many fuel-efficient technologies and designs that are identified in the joint TAR. While the analysis does not break out individual technologies, it seems clear that consumer welfare is likely improved from the shift to greater efficiency.

Future considerations

As the agencies finalize MY 2022-2025 standards and post-2025 standards are contemplated, Consumers Union urges the agencies to consider which policy mechanisms are warranted in order to reap the fuel savings and consumer benefits envisioned by the program. For example, a minimum efficiency or floor for each footprint size may be necessary to avoid either "footprint creep," (whereby automakers enlarge vehicles in order to water down their compliance requirements) or heavy cross-class subsidization (whereby automakers rely on improvements to a limited class of vehicles to avoid improvements to other vehicle classes). Setting "backstops" by vehicle size could complement the footprint-based standards to further avoid perverse incentives that undermine safety, and help provide greater market certainty and assurance that the programs' goals and benefits will be realized.

Conclusion

For the reasons stated above, Consumers Union urges the agencies to move forward with the standards as drafted in 2012 and to consider placing a minimum efficiency requirement by footprint size as part of future standards beyond 2025.

Respectfully Submitted,

Shannon Baker-Branstetter
Policy Counsel, Washington Office

September 26, 2016

By regulations.gov
National Highway Traffic Safety Administration (NHTSA)
Docket Management Facility (M-30)
U.S. Department of Transportation
West Building, Rm. W12-140
1200 New Jersey Avenue, SE
Washington, DC 20590

Environmental Protection Agency (EPA)
Air and Radiation Docket and
Information Center, (MC- 28221T)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Re: Notice of Availability of Midterm Evaluation (MTE) Draft Technical Assessment Report (Draft TAR) for Model Year 2022–2025 Light Duty Vehicle Greenhouse Gas (GHG) Emissions and Corporate Average Fuel Economy (CAFE); Doc. Nos. EPA–HQ–OAR–2015–0827; NHTSA–2016–0068

Ladies and Gentlemen:

The National Automobile Dealers Association (NADA) represents over 16,000 franchised automobile and truck dealerships that sell new and used motor vehicles and engage in service, repair, and parts sales. Together they employ more than 1,000,000 people nationwide yet the majority are small businesses as defined by the Small Business Administration (SBA). NADA appreciates the opportunity to submit preliminary comments on the Draft TAR. Among other things, these comments aim to assist NHTSA and EPA in ensuring that market conditions and market imperatives are adequately considered during the MTE process.

I. BACKGROUND

A. The MTE Process

Last July, NHTSA and EPA issued a joint MTE Draft TAR addressing federal model year (MY) 2022–25 light-duty vehicle GHG emissions and CAFE standards.[1] Issuance of the Draft TAR is the first of several steps involved with the MTE, a review process committed to in 2012 in the joint MY 2017-25 light-duty CAFE/GHG rule (2012 Rule) designed to reassess assumptions made in

[1] 81 Fed. Reg. 49217-20 (July 27, 2016).

that rule for standards set far into the future.[2] Since the Energy Policy and Conservation Act (EPCA) restricts CAFE standards to five-year increments,[3] the 2012 Rule technically only set light-duty CAFE standards for MYs 2017-21. The MTE process will support a new NHTSA CAFE rulemaking to be conducted in 2018-2020 for MYs 2022-25.[4] EPA also is using the MTE process to support a determination it intends to make by April 2018 regarding whether to modify its MY 2022-25 GHG rules. The agencies have stated an intent to coordinate their rulemaking efforts.[5]

On August 1, 2016, NADA joined some fifteen other organizations in a request for an extension of the September 26, 2016 comment period deadline set out in the July notice. Among other things, that request stressed that an additional 60-days for comments was warranted given the Draft TAR's 1,200 pages and 1,099 document references (a number of which were not available for review as of July). In part, the extension request was an implicit testament to the massive and serious efforts NHTSA and EPA have undertaken for the MTE. The agencies denied the extension request on August 22, but in doing so they stressed that there would be additional opportunities to provide input on the issues raised in and referenced by the Draft TAR.

NADA intends to take advantage of NHTSA's and EPA's commitment to "... fully consider public comments on the Draft TAR as they continue the MTE process" by providing additional input to the agencies as and when available.[6] Moreover, NADA assumes that EPA and NHTSA recognize that the Clean Air Act (CAA), EPCA, and the Administrative Procedures Act together require that interested parties be afforded adequate due process, including sufficient opportunity for notice and comment. Thus, the comments and suggestions below are NADA's *preliminary* reaction to the Draft TAR and to the issues and concerns addressed therein.

B. The Distinction Between CAFE and GHG Predictions vs. Standards

As the MTE process unfolds, NHTSA and EPA must continue to educate interested stakeholders on the difference between the CAFE and GHG *standards* and the *predicted* fleet-wide mpg averages those *standards* might deliver in MYs 2022-25. The Energy Independence and Security Act of 2007 (EISA), which amended EPCA, required NHTSA to set maximum feasible, attribute-based passenger car and light truck CAFE *standards* for a combined fleet average of *at least* 35 mpg for MY 2020.[7] The joint MY 2012-16 light-duty GHG/CAFE issued in 2010 ramps up to an industry-wide fleet-average of 35.5 mpg, some four years earlier than called for by statute.[8]

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[2] 77 Fed. Reg. 62624, 62784-8 (October 15, 2012).
[3] 49 USC §32902(a), (b)(3)(B)
[4] That rulemaking should be informed by the fact that an Administration commitment to reduce oil imports by a third by 2025 already has been achieved, largely due to increased domestic production. White House,*Blueprint for a Secure Energy Future*, (March 2011).
[5] 81 Fed. Reg. 49219.
[6] 81 Fed. Reg. 49220.
[7] Pub. L. No. 110-40, 121 Stat. 1492 (2007); 49 USC §32901, *et seq.*
[8] 75 Fed. Reg. 25324, *et seq.* (May 7, 2010).

The 2012 Rule, again relying on attribute-based passenger car and light truck CAFE *standards,* ramps up in MY 2025 to an anticipated 54.5 mpg industry-wide light-duty fleet average, a doubling of CAFE and 50 percent reduction in GHGs vs. the MY 2008 baseline. However, as NHTSA and EPA both recognize, both the 35.5 mpg and 54.5 mpg industry-wide fleet averages are *predictions* (not "standards" "targets" or "mandates") of what the combined new light-duty fleets will achieve, based on *forecasts* of the number and type of new light-duty cars and trucks motor vehicle manufacturers (OEMs) will introduce into commerce in compliance with the footprint-based *standards* imposed upon them.[9] Those *forecasts*, and any claims as to the associated gallons of fuel saved or tons of GHG emissions avoided, are based on the analyses, assumptions, models, and data upon which each rule relied.

Based on the new information examined in the Draft TAR, the MTE likely will result in a lower MY 2022-25 light-duty industry-wide fleet average *prediction,* primarily due to a fleet mix shift from cars to trucks greater than was anticipated in the 2012 Rule.[10] Again, what is critical is that NHTSA and EPA continue to clarify as and where necessary that, while the anticipated MY 2022-25 light-duty industry-wide fleet average *prediction* is lower, the underlying light-duty vehicle standards are currently as stringent today as they were when adopted four years ago.

C. A Single National Program Is Essential, But Does Not Exist

The Draft TAR suggests that there exists a formal "coordinated National Program" involving the California Air Resources Board (CARB) along with NHTSA and EPA.[11] However, despite the Administration's attempt to create a cohesive National Program, three duplicative and counter-productive standard-setting mechanisms persist, resulting in unnecessary regulatory costs and burdens. The one-regulator world contemplated by EPCA is becoming a distant memory, having been replaced by an unnecessarily complex array of NHTSA, EPA, and CARB rules issued pursuant to three different sets of laws, at least two of which arguably do not require that their standard-setting processes account for nationwide employment, customer choice, and vehicle affordability impacts. The NHTSA and EPA programs alone are replete with unnecessary conflicts that render the "single National Program" a misnomer and beg for harmonization.[12]

The most egregious element of this regulatory overload was the 2009 EPA preemption waiver grant that allowed CARB to move forward with the establishment of a redundant and conflicting light-duty vehicle fuel economy/GHG program, since adopted by several other states, that layers additional mandates for MYs 2017-25.[13] This needless and unjustified

[9] EPA/NHTSA *Draft TAR: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025*, pp. 1-7, 8 (July 2016); unfortunately, various press articles and other commentators appear to fail to understand and appreciate this distinction.
[10] *Draft TAR* at ES-7.
[11] *Draft TAR* at 1-1.
[12] NADA supports the June 20, 2016 petition filed by the Alliance of Automobile Manufacturers (Alliance) and Global Automakers (Global) that addressed various inconsistencies between, and the need to harmonize on, a variety of important issues involving the CAFE and GHG programs.
[13] 74 Fed. Reg. 32744, *et seq.* (July 8, 2009)

deference to CARB was unnecessary to the achievement of appropriate fuel economy improvements. There simply is no rational justification for the state regulation of motor vehicle fuel economy and GHG emissions. Moreover, EPCA's explicit preemption of the adoption or enforcement of state laws "related to" fuel economy was and is necessary to ensure a true "National Program" that promotes uniformity and avoids a patchwork of state mandates that undermine EPCA's safety, job loss, equity, and consumer affordability/choice considerations.

II. INTRODUCTION TO COMMENTS

Since the enactment of EPCA in 1975, NADA and its franchised dealer members have supported the goal of continuous fuel economy improvements. However, NADA has consistently and carefully scrutinized any proposed EPCA and CAA mandates given that they are designed to "push" regulated vehicles from the OEMs who build them out to the 16,000 franchised independent businesses licensed to sell or lease them to the motoring public. This scrutiny has been, and will continue to be, based on the fundamental reality that until those vehicles are sold or leased to end-user customers, no CAFE/GHG regulatory benefits are achieved.

In a less-than-30-page discussion, the Draft TAR (like the 2012 Rule itself) gives relatively short shrift to anticipated customer purchase behaviors and marketplace realities.[14] NADA urges NHTSA and EPA to devote the additional time and resources necessary to achieve a much better understanding of customer behaviors and marketplace realities, both in general and for MY 2022-2025. In doing so, the agencies should strive to fully understand potential roadblocks to the goal of leveraging customer demand to maximize fleet turnover. NADA looks forward collaborating with the agencies in this area and views the MTE as presenting an ideal opportunity to achieve a broad-based consensus on the best method and set of variables by which to measure and account for those customer behaviors and marketplace realities.

In these comments, NADA largely defers to the OEMs on issues regarding the Draft TAR's review of technological feasibility. Such issues include a proper determination of which technologies and mass reduction strategies will be feasible for MYs 2022-25 (and which will be necessary for compliance) and the appropriate lead-time for uptake and commercialization. NADA also largely defers to the OEMs on potential regulatory structure improvements necessary to reduce regulatory barriers and to enhance the cost effectiveness of compliance.

NADA is reasonably confident that the OEMs have the capability to research, design, manufacture, and incorporate technologies and designs aimed at meeting appropriate MY 2022-25 standards. But NADA has serious concerns regarding whether the OEMs will be able to comply in a cost effective and economically practicable manner, and whether those technologies and designs may end up compromising consumer choice and feature preferences. Again, these concerns arise from the critical reality that regulatory benefits will not be attained unless and until those new light-duty vehicles at issue get bought.

[14] *Draft TAR* at Chapter 6, generally.

III. NEW LIGHT-DUTY VEHICLE CUSTOMER FUEL ECONOMY PURCHASE DECISIONS

A. Customer Purchase Behaviors and Marketplace Realities

The demand for new light-duty vehicles directly results from the *desires* (need-based or otherwise) of prospective customers. Demand also reflects a *willingness* to purchase. Factors influencing customer *willingness* to purchase include consumer confidence, perceived operating costs, and expected residual values.

Assuming the requisite *desire,* prospective purchasers of new light-duty vehicles must have the *ability* to buy. *Ability* involves critical factors like financial wherewithal (overwhelmingly creditworthiness), physical capability and a driver's license (assuming the customer will be the operator), and the availability of convenient, cost-effective fuel.

For most households, a light-duty car or truck is the most expensive consumer purchase they make. And unlike for most other consumer goods, in excess of ninety percent of customers finance the new light-duty vehicles they acquire by means of a credit sale or lease, with less than ten percent involved in all-cash transactions. Thus, the single most important *ability* factor is creditworthiness. When prospective purchasers lack sufficient creditworthiness to enable a lender or lessor to finance the new light-duty vehicles they *desire*, they may be compelled to consider other options, including less expensive new vehicle choices that may suffice. But, at some point, no such new vehicle options are available, leaving them to turn to three principal alternative transportation choices. These include the used vehicle marketplace, maintaining current personal transportation (vehicle service and repair), or foregoing personal transportation altogether in favor of potentially less practical and convenient (if available) transportation options (e.g., public transportation, ride-sharing (taxis), etc.).

Importantly, it matters not in these circumstances whether the new vehicles in question offer prospective purchasers improved fuel economy performance characteristics compared to their current transportation. When underwriting loans or leases, lenders and lessors simply do not consider whether new vehicles offer more torque or horsepower, improved fuel economy, reduced GHGs, ubiquitous cup holders, or prettier paint. All that matters is whether prospective purchasers are creditworthy; that is, whether they will comply with their payment obligations as spelled out in the loan or lease. As to the new vehicles themselves, lenders and lessors use objective criteria and focus on a single key factor: the total amount being financed.

Also, vehicle lenders and lessors do not now, and cannot be expected in the future, to account for any potential reductions in vehicle operating costs, such as those that may result from lower household fuel costs, since it cannot be predicted actuarially that any such avoided costs will be saved, let alone be applied to a loan or lease. Moreover, when assessing the *willingness* of prospective new vehicle purchasers, what consumers say they might do if and when offered a new vehicle with improved fuel economy performance cannot be relied upon. This is especially true when the questioner neglects to note and to accurately quantify for the survey respondent (who may or may not ever be a prospective new vehicle purchaser or lessee) the up-front premium that must be paid for that improved fuel economy performance, along with any higher operating costs associated with that premium (e.g., additional interest, insurance, taxes).

In its comments on the proposal for the 2012 Rule, NADA focused at length on how EPA and NHTSA had failed properly to recognize and to account for the *ability* of prospective purchasers to pay for regulatory costs, concluding that the agencies had significantly understated potential impacts.[15] Those comments and an attached paper laid out three cost-increase scenarios and described how the proposal likely would impact on the ability of prospective purchasers to pay for vehicles covered by the rule, assuming their desire, ability, and willingness to do so.

Franchised dealerships have the advantage of understanding better than anyone else the degree to which prospective customers possess both the knowledge and skills necessary to make informed new vehicle purchase or lease decisions. Prospective customers typically understand their budgets, their creditworthiness, and the choices they make when considering trade-offs between various vehicle attributes. Above all else, customers always will seek to avoid paying for what they don't want.

Fortunately, franchised dealerships offer an unprecedented selection of vehicle choice, ranging from battery electrics and highly efficient hybrids to high utility pick-ups and SUVs. As the attribute-based CAFE/GHG regulatory system recognizes, vehicle selection is critical for light-duty customers with a broad spectrum of needs and wants. The MTE process must be guided by the importance of leveraging the market power of light-duty customers, avoiding scenarios that could result in excessive costs or which would restrict customer feature or performance choice, thereby serving to constrain or inhibit fleet turnover.

B. Using The Best Data

The Draft TAR exhibits an over-reliance on general public or consumer surveys that make fuel efficiency a single focus. Surveys that purport to show a wide-spread consumer desire for more fuel efficient vehicles suffer from numerous flaws, not the least of which is that consumers almost always will say "yes" to anything that sounds good and doesn't cost them anything. Unfortunately, respondents to these surveys are not called upon to trade increased costs or decreased attributes for fuel savings. So-called "intender" surveys like those conducted by Consumers Union, the Consumer Federation of America (CFA), and others purport to show what prospective purchasers want and will do based on hypotheticals, and do not reflect the priorities demonstrated by real new light-duty vehicle customers spending real money.[16]

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[15] Walton and Drake, *Willingness to Pay for MY 2025 Fuel Economy Mandates: Government Estimates vs. Economic Reality* (February 2012).

[16] Cooper, *Testimony of Dr. Mark Cooper Director of Research Consumer Federation of American on Midterm Review and an Update on the Corporate Average Fuel Economy Program and Greenhouse Gas Emissions Standards for Motor Vehicles Before the Committee on Energy and Commerce Subcommittee on Commerce, Manufacturing, and Trade Subcommittee on Energy and Power U.S. House of Representatives*, Consumer Federation of America (September 22, 2016), at 19.

The Draft TAR's failure to examine actual sales and lease data undermines its ability to inform the MTE with useful information on customer decision-making and marketplace realities.[17] NADA has accessed and is using data from the Strategic Vision *New Vehicle Efficiency Survey* (NVES), a valuable comprehensive study of actual new vehicle customers, not phantom consumers from random households. It is both perplexing and disturbing that EPA and NHTSA appear not to have accessed or to be using similar purchaser data, given their obvious value.

It verges on being intellectually dishonest to simply ask survey respondents some variation of the question "Do you want a more fuel efficient vehicle?" Who wouldn't? Indeed, using just such a question, a recent Consumers Union survey found that there is strong public support for increased fuel economy in new vehicles.[18] In fact, thirty-two percent of respondents, across all household size, incomes and vehicle types, included fuel economy at the top of a list of several other vehicle attributes that they would like to be improved in their current vehicle.

Fuel economy ranks high in these surveys, because respondents saw no consequences for answering in the affirmative. A more proper question would be "Would you be willing to pay for a more fuel efficient version of the vehicle you are planning to purchase?" More often than not, the answer will be "no."

Several data sources illustrate that consumers currently are unwilling to pay more for fuel economy technology.[19] An analysis of the Vehicle Ownership and Alternatives Study (VAOS) indicates that consumers devote very little cognitive attention to fuel costs when purchasing an automobile.[20] The VAOS survey collects information such as the demographics of respondents, the fuel costs for their current vehicles, the perceived costs for alternative vehicles with different fuel economy ratings, and their expectations of future fuel prices. Another study finds that consumers are only willing to pay $0.76 to reduce future gasoline costs by $1.00.[21]

And the willingness to pay for fuel economy does differs across income groups. One of the first studies to examine how individual discount rates affect the purchase of energy-using durables

[17] EPA states that:

> *Another potential source of information on consumer response to vehicles subject to the GHG and fuel economy standards can come from market research firms that conduct surveys of new vehicle buyers. These surveys, typically conducted a few months after purchase of a new vehicle, ask the buyer's views on a wide range of vehicle attributes. EPA has been pursuing access to one of these survey data sets.*

Draft TAR at 6-12.

[18] Comings, Allison, and Ackerman, *Consumer Savings from 2025 Corporate Average Fuel Economy Standards (CAFE),* Consumers Union (*Strong Public Support for Improving Fuel Economy in New Vehicles*, Consumers Union, (June 22, 2016). http://consumersunion.org/2016/06/2016-fe-consumer-survey/May 2016).

[19] Strategic Vision, *2009 Strategic Vision New Vehicle Experience Survey*, (2009); Strategic Vision, *2015 Strategic Vision New Vehicle Experience Survey*, (2015), Strategic Vision, *2016 Strategic Vision New Vehicle Experience Survey*, (2016), www.strategicvision.com/nves.

[20] Allcott, *Consumers' Perceptions and Misperceptions of Energy Costs,* American Economic Review 101 (2011), pp. 98–104, at 99. Designed by Allcott, the VAOS is administered by a third-party research firm using a high quality, publically available survey platform.

[21]Allcott and Wozny, *Gasoline Prices, Fuel Economy, and the Energy Paradox*, The Review of Economics and Statistics 96 (2014), pp. 779-94, at 780.

found that low-income individuals would have a much higher discount rate than high-income households when purchasing such items.[22] This means that low income individuals are willing to pay significantly less than high-income individuals for energy-saving technologies that promise lower energy consumption in the future. Further study is needed in this area, but NADA is concerned that NHTSA and EPA are ignoring real world customer purchase and preference data that might not support certain assumptions that underlie the CAFE/GHG programs.

A recent NADA survey asked respondents what they would be willing to pay for a 17 MPG increase in fuel economy. The vast majority, 68% of respondents, were willing to pay only $30 or less a month or only $360 per year, and one in four was unwilling to pay *anything* more.[23] Similar to Consumers Union, the NADA survey targeted consumers generally, not new vehicle customers specifically. Interestingly, NVES survey data shows that over 47% of consumers are unwilling to pay anything more for an alternative fuel vehicle like a hybrid.[24]

C. Valuing Fuel Economy

As noted above, a proper understanding of new light-duty vehicle consumer choice requires a recognition that prospective purchasers have competing transportation choices from which to pick. A second factor, also noted above, is that prospective purchasers face various constraints on their *ability* and *willingness* to buy or lease. Third, and no less important, is that no single feature or vehicle attribute is considered by customers in isolation; rather each individual customer trades off numerous features to arrive at their optimal basket of vehicle qualities. And, fuel economy is but one of hundreds of these vehicle quality choices.[25]

Indeed, many pollsters who conduct so-called "intender" surveys fail either (1) to accurately inform respondents about the degree to which the up-front cost premium and higher operating costs will off-set any potential reductions in household fuel expenses, or (2) to educate "intender" respondents of other potential trade-offs that may be involved with vehicles designed to achieve improved fuel economy performance. These pollsters also fail to couch the cost premium of improved fuel economy performance in comparison to such transportation alternatives as used vehicles, vehicle service and repair, and transit. To be sure, consumer surveys can prove valuable in helping to assess and predict actual behavior, such as when they evaluate why consumers do what they do (or did what they did). But survey results with queries aimed at determining consumer willingness to pay for fuel economy performance 6 to 9 years into the future and that fail to provide respondents with information appropriate to make reasoned responses, are of little or no value to proper NHTSA and EPA analyses.

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[22] Hausman, *Individual Discount Rates and the Purchase and Utilization of Energy-Using Durables*, Bell Journal of Economics 10 (1979), pp. 33–54.
[23] NADA, *NADA Consumer Survey on Fuel Efficiency* (2016)
[24] See footnote 17.
[25] This reality partially explains why consumers do not value fuel efficiency costs at 100% of the fuel economy gains. For any given customer, the higher or lower a vehicle's fuel efficiency relative to other vehicle characteristics, the greater or lesser its expected net present value will be.

To the extent prospective purchasers are unwilling to pay for some or all of the regulatory premium for mandated fuel economy improvements, it will negatively impact new vehicle sales and reduce forecasted regulatory benefits. The Draft TAR characterizes increased fuel economy performance (i.e., fuel cost reductions discounted to the present) as the future benefit that offsets the higher up-front and operating costs needed to buy such performance. In and of itself, this cost/benefit analysis is problematic given that correct estimates of future fuel savings are not simple financial calculations in which one can estimate a discount rate, as a corporation might for its cost of money when calculating the net present value of a potential project. EPA and NHTSA must accurately consider the expectations of able and willing customers, because those expectations will ultimately determine their behavior in the marketplace.[26]

Moreover, when assessing how prospective purchasers value fuel economy improvements, the financial benefits of reduced future fuel savings cannot be separated from the utility lost by necessary reductions to other vehicle qualities and performance. For example, if a customer values a fuel economy increase of one mpg at $500, but gaining the one mpg forces a reduction in power or safety valued at $600, then the value of her fuel economy gain is negative.

Statistical models that fail to properly account for the tradeoff between fuel economy and other vehicle attributes will generate a false positive relationship between price and fuel costs, highlighting the significance of these tradeoffs in the mind the average consumer. Based on these revealed preferences, customers are unlikely to value mandated fuel economy improvements more than the sum of the higher up-front costs for such improvements and other reductions to vehicle quality. In fact, when more reasonable estimates of per vehicle regulatory costs are used, the perceived net benefit will be negative for the average customer. As a result, many prospective purchasers of new light-duty motor vehicles will be unwilling to "pay-up" for costly fuel economy improvements, instead opting for less expensive and less fuel efficient options, such as used vehicles or the vehicle service and repair market.

EPA and NHTSA appear to suggest that there is no consensus regarding how customers value vehicle fuel efficiency and that they may be myopic or arbitrary in their assessment of future fuel savings.[27] To the contrary, even a cursory look at the vehicle characteristic choices customers make indicates that there is great intertemporal variation as to which vehicle attributes consumers prefer. Far from consumers being myopic or inconsistent, customers vary their preferences based on a wide variety and number of inputs and values, not the least of which are economic conditions and gasoline prices.

EPA and NHTSA state that, "[i]f consumers are doing a good job of getting their efficient amount of fuel economy, their willingness to pay for additional fuel savings, revealed in their

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[26] As illustrated in and supported by a paper NADA filed with its comments on theproposed 2012 rule, prospective purchasers form expectations of the net present value of future fuel savings that are related, but not closely related, to a standardized financial calculation. Walton and Drake, *Willingness to Pay for MY 2025 Fuel Economy Mandates: Government Estimates vs. Economic Reality*, (February 2012).
[27] *Draft TAR* at 6-6.

purchase decisions, should approximately equal future fuel savings."[28] This would be true if customer fuel efficiency purchase decisions were binary in nature...but they are not. In reality, light-duty motor vehicles cost tens of thousands of dollars and contain hundreds of different attributes of which fuel economy is just one. There are experiential qualities that vary with specific fuel efficient technologies, and there are other attributes that are more highly valued than fuel economy. Moreover, they are different for each customer and they change over time.

In 2009 actual customers ranked fuel efficiency 10th out of the 50 attributes measured by the NVES, but by 2015 this had fallen to 20th, and by 2016 to 26th.[29] Clearly, light-duty vehicle customers in 2009 ranked vehicle characteristics differently than customers do today. In large part, the relative ranking of fuel economy tracks with the fact that average annual fuel costs have fallen from over $2,000 a year to $1,200 in 2016.[30]

Light-duty customers do tend to misinterpret future gasoline prices.[31] But they are no worse than anyone else at forecasting future gasoline prices.[32] Moreover, it may not be rational or even reasonable for customers to base vehicle purchase decisions on future oil prices. EPA and NHTSA should continue to attempt to predict future fleet mix based on various fuel price and supply assumptions; but should not forecast the willingness of consumers to purchase certain fuel efficiency technologies in MYs 2022-25 based on forecasted fuel prices and supply.[33]

The Draft TAR also states that,

> *". . .the agencies estimate that fuel saving technologies, in addition to reducing GHG emissions and improving energy security, pay for themselves within a few year payback period, and thus save consumers money. Despite this, development and uptake of energy efficiency technologies lags behind adoption that might be expected under these circumstances. The implication is that private markets do not provide all the cost-effective energy-saving technologies identified by engineering analysis."*[34]

In reality, light-duty customers choose highly fuel efficient vehicles when needed, and those vehicles are available if and when customers want to purchase them. Again, EPA and NHTSA ignore the fact that customers trade off a myriad of vehicle attributes when deciding what to purchase or lease. Purchase decision-making simply does not involve a binary choice between fuel efficient versus not fuel efficient as the Draft TAR suggests.

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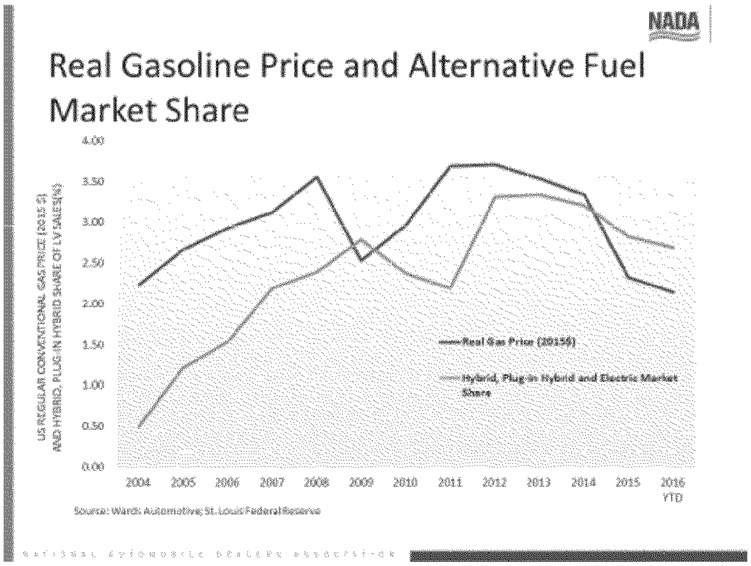
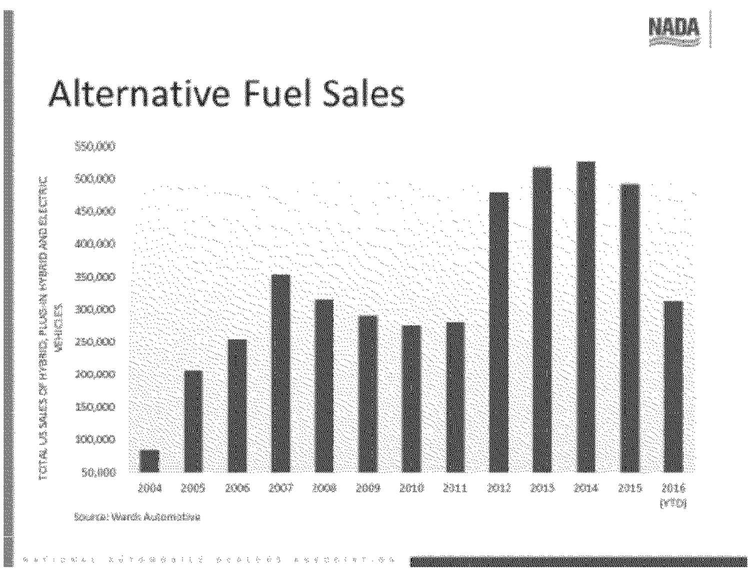
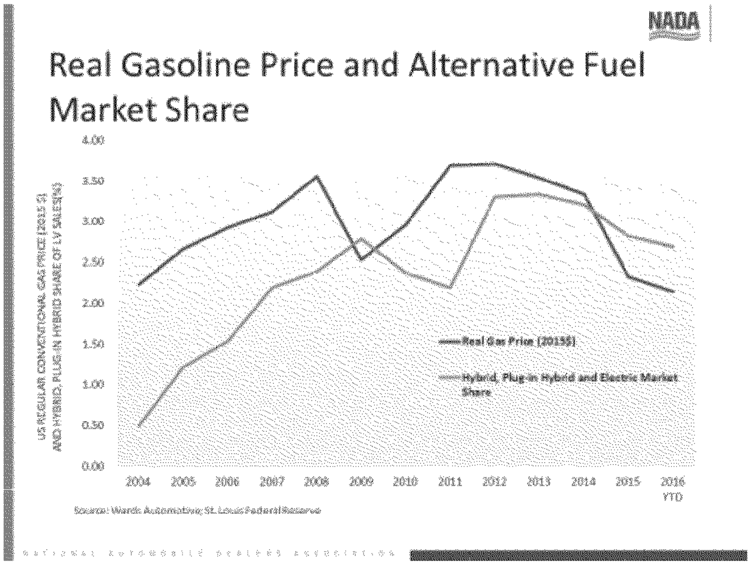
[28] Id.
[29] See footnote 17.
[30] American Automobile Association, *Your Driving Costs 2016*, (2016), http://exchange.aaa.com/automobiles-travel/automobiles/driving-costs/#.V-Qs3vkrJhE
[31] Alcott and Wozny at 780-81.
[32] Allcott at 99.
[33] Clearly the fuel price assumptions set out in the 2012 rule, based on then available Department of Energy data, were wrong. U. S. Energy Information Administration (EIA), *Annual Energy Outlook 2011 with Projections to 2035*, Report. No. DOE/EIA-0383 (April 2011). http://205.254.135.7/forecasts/aeo/pdf/0383(2011).pdf
[34] *Draft TAR* at 6-5.

Customers appear to fairly accurately value fuel economy technologies and strategies relative to other vehicle attributes. A look at alternative fuel vehicle sales illustrates how customer preferences can change with fuel prices. As demonstrated by the following three graphs, light-duty customers reject more fuel efficient vehicles when costs, both financial and experiential, outweigh any financial savings, as has clearly been the case with hybrid and plug-in electrics.







Hybrid electric vehicles have been on the market for some 15 years and exhibit few performance and attribute compromises when compared to conventionally-fueled, comparably-equipped vehicles of similar footprints. Yet often more expensive hybrids exhibit considerable market sensitivity and have moved from 3% of light-duty sales in 2013 to 2% in 2016. Moreover, there is little reason to believe that the demand for hybrids will increase, as their sales have historically tracked with fuel prices.

For plug-in electric vehicles, customers may face both *decreased vehicle utility* and *increased vehicle prices*, a reality that inspired NADA to publish a Guide designed to assist dealerships with marketing them to customers.[35] It is concerning to NADA, as it should be to NHTSA and EPA, that that the only 2015 MY products that meet MY 2025 standards are advanced technology vehicles (e.g., hybrids, plug-in hybrids, fuel cell electrics, or battery electrics).

As noted above, new light-duty customers trade off a host of attributes, with fuel economy being only one factor for consideration. Consistently more important considerations include safety, reliability, durability, handling, ride, and utility. For example, many customers desire motor vehicles that offer attributes necessary to meet practical needs such as the increased family capacity of a sport utility vehicles or the cargo-hauling capacity of a pick-up truck.

CFA curiously suggests that "[t]he public is not as enamored of gasoline powered muscle cars and truck as the automakers claim."[36] To the contrary, new light-duty customers are in fact enamored with light trucks.[37] According to Edmunds.com:

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[35] A plug-in vehicle marketing workshop also was conducted at NADA's 2016 National Convention. Greenhaus, *A Dealer Guide to Marketing Electric Vehicles,* NADAUniversity (2016), www.nada.org/onlinelearning/.

[36] Footnote 13 at 9.

[37] Edmunds.com, *EV and Hybrid Loyalty Falls to All-Time Low, Even as Overall Fuel Economy Thrives, Says Edmunds.com*, (April, 2016). www.edmunds.com/about/press/ev-and-hybrid-loyalty-falls-to-all-time-low-even-as-overall-fuel-economy-thrives-says-edmundscom.html

...hybrid or electric trade-ins are more likely to go toward the purchase of a SUV (33.8 percent) than another hybrid or EV. The trend is even more apparent when looking only at EV trade-ins — 25.7 percent of EV trade-ins went toward the purchase of a SUV, compared to just 4.8 percent that went toward another EV".[38]

Note that during periods of unexpected gasoline price shocks where vehicles may not fully match consumer preferences for fuel efficient vehicle design, OEMs may discount prices until more fuel efficient models become available.[39]

D. Consumer Choice Models

The Draft TAR states that "[a]t this point, then, EPA does not plan to use this or another vehicle choice model in its current modeling work. We encourage further research in the validation of these consumer choice models for policy analysis."[40] NADA recognizes that it is not an easy process to properly understand and construct a valid consumer choice model. However, given the issues and concerns expressed above, it is incumbent upon EPA and NHTSA to utilize the very best real world data and to construct and validate a consensus vehicle choice model as part of the MTE process. Real-world light-duty vehicle purchaser decision-making and preferences cannot be ignored, especially in light of ample evidence that customers place a low value on fuel economy and fuel saving technologies. Again, it should be of great concern to the agencies that if little or no value is placed on fuel economy when actual purchase decisions are made, customers will avoid paying for the fuel economy technologies and strategies required to comply with NHTSA's CAFE and EPA's GHG programs, resulting in an underachievement of regulatory program benefits and economic disruption for OEMs, dealers, and their employees.

E. Consumer Payback Periods

The Draft TAR requests comment on consumer payback periods.[41] This is a salutary area of research in which NADA intends to engage further. But it is clear that overly simplified payback methods overstate potential fuel economy savings. Certainly, real-world finance, opportunity, and additional maintenance costs need to be accounted for. Based on current customer preferences and actual sales data, EPA and NHTSA should assume that actual light-duty customers find acceptable payback periods of significantly less than five years. Except in rare instances of high and increasing fuel prices, consumers who view fuel economy as an important purchase criterion will be hard pressed to make the case for buying a more fuel efficient new vehicle if the up-front capital costs associated with doing so cannot be recouped in short order.

[38] Ibid.

[39] Manufacturers offset up to 40% of the change in cost of fuel due to gasoline price fluctuations.Langer and Miller, *Automakers' Short-Run Responses to Changing Gasoline Prices*, The Review of economics and Statistics 95 (2013), pp. 1198–1211.

[40] *Draft TAR* at 6-5.

[41] ". . .consumers appear to take fuel economy into account when buying vehicles, but how precisely they do it is not yet clear." *Draft TAR* at 6-7.

The long term picture is fraught with unknown variables, including the price of oil, the value of the brand being purchased, and future vehicle segment preferences. Short payback periods tend to be a form of risk mitigation for unproven and perhaps unrealistic assumptions with variables like fuel savings, which fluctuate with unpredictable gasoline prices. It is perfectly rational, and indeed normal, for customers to aggressively discount unpredictable savings.

As evidenced by the relatively low ranking of fuel efficiency in the NVES, payback periods will vary and are heavily affected by a customer's indifference curve relative to the variety of baskets of vehicle attributes under consideration, rather than based on a one versus one trade off of vehicle qualities. It is likely that customers prefer a shorter payback period for vehicle characteristics that they value little. For example, when given a choice, customers prefer other features over fuel economy improvements and thus expect a much quicker payback for related costs. Of course, customer preference baskets change over time in response to factors like changing economic conditions and fuel costs.

F. Economic Impacts

As stated above, NADA lacks a first-hand knowledge of the nature and estimated cost of the technologies and strategies that will be necessary to achieve compliance with the MY 2022-25 CAFE and GHG standards, and defers to the OEMs on such matters. Nonetheless, given that the the *ability* and *willingness* of prospective purchasers to pay for fuel economy improvements keys on the accuracy of such costs, NADA is concerned that the Draft TAR may have significantly underestimated these costs[42]

For example, recent projections by the Center for Automotive Research (CAR) illustrate average per vehicle costs several times those set out in the Draft TAR. The CAR study outlines nine technology/strategy scenarios with costs of compliance ranging from $2,000 to $6,000 per vehicle, based on fuel price expectations ranging from $2.44/gallon to $4.64/gallon. In eight of the nine scenarios considered, auto manufacturing and dealership employment is projected to fall. For one particular scenario involving average per vehicle compliance costs of $6,000, and fuel prices of $2.44/gallon, auto manufacturing employment is projected to fall by 137,900 jobs, and dealership employment is projected to fall by 99,000 jobs.[43]

Of course, total employment losses will be much greater due to multiplier effects. Again, for the scenario where compliance costs average $6,000 per vehicle and gas prices are $2.44/gallon, employment losses across the U.S. economy are projected to be as high as 1.13 million jobs.[44] If, as NADA suggests, the value of fuel economy savings to prospective purchasers continues to be less than these marginal compliance costs, serious economic consequences will result.

[42] "Relative to the reference case (i.e., the MY2021 standards), a new MY 2025 vehicle is estimated to cost roughly $900 to $1,000 more due to the addition of new GHG reducing/fuel economy improving technology."*Draft TAR* at 12-41.

[43] McAlinden, Chen, Shultz, and Andrea, *The Potential Effects of the 2017-2025 EPA/NHTSA GHG/Fuel Economy Mandates on the U.S. Economy,* Center for Automotive Research (2016), at 1-2.

[44] Ibid.

A $2,000 to $6,000 increase in per vehicle cost will constrain the ability of prospective purchasers to obtain a loan, thereby constraining vehicle affordability. As NADA demonstrated in great detail in its comments on the 2012 Rule and as discussed above, lenders do not take into account fuel savings or decreased operating costs when underwriting loans or leases for new or used motor vehicles. For any given loan or lease term and rate, increased up-front costs will always increase monthly payments, thereby making new light vehicles less affordable.

A cursory search of two vehicle models offered with highly fuel efficient gasoline versions and hybrid versions also illustrates cost differentials far greater than the Draft TAR suggests will be the marginal average cost increase between MY 2021 and MY 2025. Again, this illustration raises concerns that EPA and NHTSA may be significantly underestimating real world conditions.

	Powertrain	**Price**
2017 Toyota Camry	Gas	$ 23,070
	Hybrid	$ 26,790
	Difference	$ 3,720
2017 Ford Fusion	**Powertrain**	**Price**
	Gas	$ 22,120
	Hybrid	$ 25,185
	Difference	$ 3,065

NADA also is concerned that, as compliance costs increase, customers will suffer significant and regressive welfare losses. A recent study estimates consumer welfare losses over a five-year period of roughly $8 billion.[45] Low income households will eventually suffer the largest welfare losses, as the CAFE/GHG standards drive up used vehicle prices over time.[46] Estimates of these welfare losses as a fraction of income show them to be more than three times as large for low-income households as compared to high-income households.[47] In addition, there will be consumer surplus that will not be able to be recaptured and will be forgone as a deadweight loss. NADA intends to submit further information on this issue.

The Draft TAR claims that it is "[d]ifficult, if not impossible, to separate the effects of standards on vehicle sales and other characteristics from the impacts of macroeconomic or other forces on the auto market."[48] To the contrary, it's clear that higher prices for features that consumers do not want will either lead to lower sales or to welfare loss within the industry.[49]

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[45] Klier and Linn, *New-vehicle Characteristics and the Cost of the Corporate Average Fuel Economy Standard.* The RAND Journal of Economics 43.1 (2012), pp. 186-213.
[46] Jacobsen, *Evaluating US Fuel Economy Standards in a Model with Producer and Household Heterogeneity*, American Economic Journal: Economic Policy 5.2 (2013), pp. 148-187.
[47] Ibid at 150.
[48] *Draft TAR* at 6-1.
[49] Klier and Linn, Table 6, at 37.

IV. CONCLUSION

The automobile industry has traveled a steep technology path since 1975, resulting in astounding improvements to light-duty cars and trucks, which are lighter and more powerful, yet safer and more fuel efficient, than ever. OEMs will continue to move along this technology path, but only if it allowed to deliver to new vehicle showrooms products that are acceptable by, and affordable to, consumers. Vehicles must be affordable up-front and offer a total value package that includes improved fuel economy, but with no safety or performance trade-offs.

Typically, customers buying new vehicles are acquiring safer and more fuel efficient vehicles. Fortunately, new light-duty vehicle sales have been strong since 2012, in large part driven by pent-up demand, record low interest rates, strong credit availability and favorable credit terms, and population growth. Unfortunately, new light-duty vehicle sales appear to be plateauing and cannot be counted on to continue at the same rate into the MY 2022-2025 timeframe.

Like a clean environment and safe roads, affordable and reliable personal transportation is a fundamental aspirational staple of our society and an essential element of the economic fabric for most families and individuals all across the U.S. NADA has been, and always will be, vigilant on how potential regulatory mandates impact on new and used motor vehicles. Simply put, it would be impermissible to allow mandates to move forward if to do so would mean driving up vehicle costs beyond the financial reach of working men and women. The CAFE/GHG mandates for MY 2022-25 will impose a regulatory tax on vehicles and, like all taxes, when they reach a certain point, prospective purchasers stop buying and everyone loses. In sharp contrast, flexible, fact-based standards that reinforces customer preferences for newer vehicles will accelerate fleet turnover, thereby simultaneously providing numerous environmental, safety, economic, and national security benefits.

Numerous surveys and statistical evidence suggest that prospective purchasers must be influenced into valuing efficiency technology to help create a willingness to pay. Supply-side CAFE/GHG mandates regulate what OEMs introduce into commerce, but do nothing to create customer demand for fuel efficiency technologies and strategies. A suggestion repeatedly made in NADA's CAFE/GHG rulemaking comments and testimony is for NHTSA and EPA to devote more attention to educating with the goal of influencing prospective purchasers on the purposes and goals of their regulatory programs.

Specifically, NHTSA and EPA should consider engaging in targeted efforts designed to get the motoring public to understand that when they pay more for MY 2022-25 vehicles, they will be helping to reduce America's dependency on foreign oil and to reduce GHG emissions.[50] It is the province of government to educate and engage on the reasons *why* significant regulatory costs are being imposed on essential consumer products. This is especially true when, unlike for

[50] "Policy must influence something that consumers pay attention to in order to actually affect the choices consumers make." Busse, Knittel, and Zettelmeyer, *Are Consumers Myopic? Evidence from New and Used Car Purchases*, American Economic Review 103 (2013), pp. 220–256 at 221.

motor vehicle safety, the sought-for benefits associated with the CAFE and GHG programs are not well known.[51] NADA looks forward to working with NHTSA and EPA in this regard.

On behalf of NADA, I thank EPA and NHTSA for the opportunity to comment on this matter.

Respectfully submitted,

Douglas I. Greenhaus

Douglas I. Greenhaus
Chief Regulatory Counsel,
Environment, Health and Safety

[51] The reality is, fully 70% of consumers want Washington to prioritize *"keeping car buyer costs reasonable, ensuring people can buy the cars they really want or need, and making it possible for average people to afford cleaner cars," a* more than a two to one margin over the 30% who prioritize *"protecting the environment, limiting carbon emissions to prevent climate change, and reducing dependence on oil."* NADA, *NADA Consumer Survey on Fuel Efficiency* (2016). Given this reality and the public's general lack of understanding of the connection between the higher costs they must pay to reduce GHG emissions, a campaign comparable to "Give-a-Hoot, Don't Pollute", "Only You Can Prevent Forest Fires," or "Keep America Beautiful" may be warranted.

INTERNATIONAL UNION, UNITED AUTOMOBILE, AEROSPACE & AGRICULTURAL IMPLEMENT WORKERS OF AMERICA – UAW

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September 26, 2016

National Program for Federal Standards for Greenhouse Gas (GHG) Emissions and Corporate Average Fuel Economy (CAFE) for Light-duty Vehicles
Docket ID No. EPA-HQ-OAR-2015-0827; Docket No. NHTSA-2016-0068

Comments Submitted by
President Dennis Williams, International Union, UAW
[SUBMITTED TO *www.regulations.gov*]

The Honorable Gina McCarthy, Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue NW
Washington, D.C. 20460

The Honorable Mark Rosekind, Administrator
National Highway Traffic Safety Administration
1200 New Jersey Avenue SE
Washington, D.C. 20590

Dear Administrator McCarthy and Administrator Rosekind,

The International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW) appreciates the opportunity to comment on the Environmental Protection Agency (EPA), Department of Transportation National Highway Traffic Safety Administration (NHTSA), and the California Air Resources Board's Draft Technical Assessment Report (TAR) for light-duty vehicle corporate average fuel economy (CAFE) and greenhouse gas (GHG) standards for MYs 2022-2025 (Docket ID No. EPA-HQ-OAR-2015-0827; Docket No. NHTSA-2016-0068).

We are proud of the role we played in reaching a consensus among a wide variety of stakeholders including the Obama Administration, federal and state regulators, the automobile industry, environmental advocates, elected officials, and many others to significantly reduce greenhouse gases and raise the average fuel economy of passenger vehicles sold in the United States in creating the "One National Program" that was implemented in 2012. We reject the false calculus, espoused by some, that environmental regulations always cost jobs. It is not a zero-sum equation. Well-constructed regulations crafted with input from stakeholders can protect the environment while simultaneously supporting existing jobs and creating jobs in new advanced technology sectors of the economy. This is not theoretical; UAW members know firsthand that CAFE and GHG standards have spurred investments in new products that employ tens of thousands of our members.

The need to address climate change is real and urgent. We must act to protect our future and the future of our children and grandchildren. There is no scientific debate on the connection between fossil fuel consumption, rising carbon dioxide levels in the earth's atmosphere, and climate change. Climate change is real and we ignore it at our own peril. The need for a comprehensive strategy to address climate change could not be clearer and we all have responsibility to act.

There have been substantial challenges implementing existing regulations in the past and significant challenges are likely for MY 2022-2025 as the stringency standards significantly increase. In future years, regulations must strike a delicate balance in order to achieve their objectives while not adversely impacting working people and domestic manufacturing. MY 2022-2025 standards could prove to be a win-win for the environment and the economy.

Importance of the U.S. Motor Vehicle Industry

The United States' motor vehicle industry is large, profitable, competitive, and one of the key cornerstones of our manufacturing sector. The domestic motor vehicle assembly and parts industries are vital to the U.S. economy and it is imperative that we remain strong and competitive now and in the future. Nearly 900,000 people work in the auto and auto-parts manufacturing sectors alone. In fact, the majority of UAW members and retirees work in or are retired from the motor vehicle assembly and parts industries. All of these workers, their families, and their communities are impacted by these standards. It is important to acknowledge that the industries' economic impact extends far beyond those directly employed by manufacturers. When jobs from other sectors that are dependent on the industry are included, the auto industry is responsible for 7.25 million jobs nationwide, or almost 4% of private-sector employment.[1] The impact of regulations must not be viewed in a vacuum but rather in the context of how they could impact families and communities.

We urge NHTSA and EPA to keep the following principles in mind when modifying regulations for MY 2022-2025.

A Single National Program

The CAFE and GHG emission standards have to be a single National Program—harmonized and applicable in every state of the country. California is the only state with the ability to adopt its own motor vehicle standards per the Clean Air Act. We urge EPA and NHTSA to continue information sharing and communication with the CARB to create a single harmonized National Program. To do otherwise is inconsistent with the realities of the market.

In this vein, we support appropriate modifications to further harmonize the programs. For example, by law, NHTSA has a limitation of 5 years during which these credits can be carried forward while EPA has no such guidance or restrictions. EPA has appropriately allowed its credits to exist for as many as 11 years. This flexibility allows automakers to "bank" credits in the early years and use them later when the stringency is higher. This mechanism creates incentives for companies to invest in new technologies and work to over-comply with standards. Unfortunately, credits expire after five years under the NHTSA program thus undermining this important incentive and the very goals of the regulations.

The treatment of off-cycle technologies provides another example of the need to further harmonize. Off-cycle technologies achieve fuel economy improvements not captured by standard test procedures. Engine start-stop technologies, solar panels on hybrids, and certain aerodynamic improvements fall into this category. Measures auto makers take to improve efficiency and reduce emissions should be accounted for. Fortunately, for MY 2014 and later, EPA recognized the benefit of these technologies and provided off-cycle credits to automakers that implemented these and other similar technologies. EPA provided a pre-approved list of technologies and credit values. In addition, automakers can petition to expand the list. NHTSA has a similar program starting in 2017 but is not providing those credits earlier. Credits should be applicable for all programs and model years.

These are but two examples of the need to further harmonize programs during the midterm review process. We appreciate that some of these changes require congressional action. We urge EPA, NHTSA, and CARB to work with Congress and take appropriate targeted measures to create a truly uniform program.

Domestic Manufacturing

MY 2022-2025 rules must recognize the long term importance of manufacturing a diverse fleet of motor vehicles. Emission and fuel efficiency standards must do all that is possible to incentivize investment and manufacturing in the United States. It is our national economic interest to have a diverse set of vehicles manufactured in the United States.

Regulations should not be altered to weaken the minimum domestic passenger car standard or "domestic backstop" for MY 2022-2025. We strongly oppose any effort to do so. In fact, it should be enhanced. Regulations should never incentivize automakers to move production or import more passenger cars as a path towards compliance with the standards. Simply put, the greater importation of efficient vehicles ultimately undermines domestic manufacturing, workers, and communities.

Program Flexibility

This is by no means a static industry as major advances in technology are happening in real time. Advances in technology and changes in consumer preferences are clearly unpredictable and regulations should recognize this reality. For example, in recent years, low gas prices have created disincentives for consumer to buy expensive vehicles with new technologies. The payback period is longer for consumers to recover their investment. These basic realties make it extremely important for EPA and NHTSA to maintain and enhance flexibilities in the program.

Furthermore, the One National Program doesn't exist in a regulatory vacuum. We urge NHTSA, EPA, and other regulatory agencies to refrain from altering intersecting regulations outside of this review and potential rulemaking process. This can create disruption and uncertainty for the industry. This is a major concern in light of numerous initiatives undertaken to combat climate change.

It is critical for the regulations to maintain the domestic footprint formula that is currently being used. Automakers need significant flexibility to meet stringency requirements via a mix of different technologies and paths driven by competitive advantages, market position, brand, customer demands, and product cadence. Flexibility is key to the program's continued success. Regulations should be technology neutral and not overly prescriptive. The UAW supports maintaining and, when necessary, improving flexibility provisions to allow automakers to successfully meet the standard's stringency levels going forward.

Thank you for considering our views.

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1. Hill, Kim, Deb Menk, Joshua Cregger, and Michael Schultz. Contribution of the Automotive Industry to the Economies of All Fifty States and the United States. January 2015.

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Comments Concerning the Draft Technical Assessment Report for the Mid-term Evaluation of Model Year 2022-2025 Light-duty Vehicle Greenhouse Gas Emissions and Fuel Economy Standards

Referencing Docket ID Numbers:

EPA-HQ-OAR-2015-0827

NHTSA-2016-0068

Prepared on behalf of:

Union of Concerned Scientists

By

David W. Cooke, Ph.D.

I. Introduction

The 2012-2016 and 2017-2025 fuel economy and greenhouse gas emissions standards for light-duty vehicles represent the largest single policy step towards reducing greenhouse gas emissions and oil usage in the United States. The Technical Assessment Report (TAR) that the agencies have drafted shows that these standards are working to put more efficient vehicles on the road, and cars and trucks under these standards are flying off dealers' lots at a record-setting sales pace. The TAR also shows that a lot has changed in the industry since the 2017-2025 final rulemaking (FRM), some of which has resulted in unforeseen technology advancements that could underpin even stronger standards and other developments that are leading to increases in emissions and underscores exactly what is at stake in this regulatory process.

The standards are resulting in the deployment of the most efficient cars and trucks ever—but because the share of trucks and SUVs is much higher than anticipated, the nation is not on track to achieve an average of 163 grams CO_2-equivalent per mile (g CO_2e/mi), but instead on track for 175 g CO_2e/mi. This will result in more than 226 million barrels of oil use and 100 million metric tons of emissions in 2040 more than expected in the FRM.[1] Clearly it is critical that the agencies seriously examine through the mid-term evaluation whether the current standards are forcing enough technology to market and truly represent what is maximally feasible in the timeframe of the rule.

The TAR represents a significant first step towards strengthening the regulation. Despite low gas prices, these rules remain extremely cost-effective, with the average driver saving money the moment the car leaves the lot (Comings, Allison, and Ackerman 2016). Manufacturers are deploying tremendous resources to research new technologies to reduce fuel use, which has resulted in technologies like variable compression ratio and high compression ratio engines that the agencies hadn't anticipated as well as significant improvements to the mechanics of continuously variable transmissions and the ability to integrate different types of advanced materials, which continue to push low-cost, effective technologies further than originally thought. These developments speak to the ability for manufacturers to push conventional vehicles even further than anticipated.

At the same time, more advanced technologies are being deployed thanks to the adoption of zero emissions vehicle policies by California and nine other states. While these technologies will likely only be deployed in low volumes by 2025, this new development shows the path forward to even stronger standards beyond 2025. Furthermore, any near-term adoption of zero emission vehicles serves to only improve manufacturers' ability to comply with the standards, standards which they currently exceed.

[1] UCS analysis; see summary figure in UCS 2016a.

The TAR is an interim report that shows both how far the industry has come, and how much farther it can go. The TAR demonstrates that the 2025 fuel economy and greenhouse gas emission standards finalized in 2012 are achievable with technologies being deployed and adopted by consumers today. Fully implementing these standards will deliver billions of dollars in savings to consumers. Costs for implementing the standards as written are less than originally anticipated, signifying that manufacturers could meet even more stringent standards for 2025. Below we have outlined ways to improve the data in the TAR to ensure that any future proposed standards rely on the most up-to-date and accurate data, and thus result in the maximum feasible reductions of oil usage and greenhouse gas emissions.

II. Implication of the Agencies ' Different Technology Assessments

To assess the ability of auto makers to comply with regulations, the agencies rely upon two different models, the Volpe model (NHTSA) and OMEGA (EPA). The need for these two models comes out of the different regulatory restrictions and unique authorities given to the agencies under the Clean Air Act, the Energy Policy and Conservation Act of 1975, and the Energy Independence and Security Act of 2007; however, the technical inputs to these models should be as similar as possible in order to ensure that the National Program can be achieved with a single fleet.

For the Draft TAR, the two agencies used very different approaches to assess the costs and technological potential for technologies to reduce fuel use and emissions. EPA extensively employed its own, freely accessible ALPHA full-vehicle modeling tool, which was extensively peer-reviewed and benchmarked against its work at its laboratory, which also resulted in numerous peer-reviewed publications.[2] This laboratory analysis allowed for combinations of technologies not available on the road today to be analyzed, including both combinations of turbocharged engines with advanced transmissions and future high-compression ratio engines (e.g., Ellies, Schenk, and Dekraker 2016). NHTSA relied primarily on the analysis of Argonne National Laboratory (ANL), which used its Autonomie model to simulate a wide array of technology combinations. This was supplemented with proprietary engine maps developed by IAV Automotive Engineering for DOE, since ANL's Autonomie benchmarks have focused exclusively on alternative fueled vehicles over the past five years, with the most recent turbocharged engine dating back to 2010.[3] For costs, EPA commissioned a number of teardown studies, which both agencies agreed in the FRM is the best method for developing direct cost

[2] A list of the agency's publications can be found at *www3.epa.gov/otaq/climate/mte.htm#epa-publications*.
[3] The most recent turbocharged gasoline vehicle benchmarked at ANL's Advanced Powertrain Research Facility was the 2012 Ford EcoBoost 3.5L V6. That engine actually dates back to a 2007 Lincoln MKR concept vehicle, but it was not put into production until the 2010 Lincoln MKS.

data. While the agencies largely assessed similar direct costs for technologies, they have chosen to use significantly different estimates for attributing indirect costs.

While there is indeed value to showing that multiple pathways toward compliance are achievable, the basis for assessing future technology potential and costs should be measured from the same starting point. Even while utilizing different analytical tools, this should be both possible and desirable. This level of harmonization was achievable in the FRM for 2017-2025 and should remain a goal through the mid-term evaluation.

To foster and encourage a cohesive technological assessment, we have highlighted some areas with the greatest disparity as well as some areas in which the models can be more appropriately synchronized in their approaches, even within the constraints of separate regulatory authority. These discrepancies have a significant impact on the assumed costs to meet the 2025 standards.

In order to assess the magnitude of the impact, we have modified the inputs to NHTSA's Volpe model to better match those of EPA and simulated compliance with the 2025 standards under these modified constraints. The assumptions and underlying data for each modeling run are described in greater detail in the sections below. Using the Volpe model, we illustrate that compliance with the 2017-2025 regulations would result in an increase in price for consumers of just $1299 in 2025—this is consistent with the estimate from EPA using its OMEGA model and represents a reduction in costs of nearly $500 from NHTSA's estimate in the TAR (Table 1). It also represents a significant reduction from the 2017-2025 FRM, showing how the numerous technological changes that have occurred since the rules were first finalized are resulting in lower costs for both manufacturers and consumers.

TABLE 1. UCS analysis of the average regulatory cost per vehicle to comply with the 2017-2025 regulations, as modeled with NHTSA's Volpe model. The baseline technology scenario represents NHTSA's analysis in the TAR—all other scenarios indicate individual UCS modeling runs based on alternate assumptions described in Sections II.A–II.C. and the ensuing reduction in compliance cost, compared to the baseline. Finally, these adjustments were modeled in total, resulting in an overall assessment of the cost of compliance that is nearly $500 less than NHTSA's costs in the TAR and nearly identical to those of EPA ($1286).

Technology Assumption	Cost of Compliance in 2025[4]
Baseline technology package with RPE:	**$1695**
Adjustments to baseline package:	
Using ICM instead of RPE for indirect costs	–$205
Ensuring performance neutrality	–$233
Allowing for CVTs to improve	–$24
Improved effectiveness of HCR engines	–$1
Reduced effectiveness of cylinder deactivation	$47
Baseline fleet complies with ZEV regulation	–$102

[4] To compare with the 2017-2025 FRM as well as the results of EPA in the TAR, we are using 2025 compliance costs.

HCR engines can be used by all manufacturers	–$1
Incorporation of all adjustments:	**$1299 (–$480)**

In addition to the modeling runs, we highlight additional concerns that could not be captured via the Volpe model, such as the agencies' choice of baseline fleet and limits to mass reduction. These would have an impact on compliance costs as well, but we have not included any estimates of that impact in Table 1.

A. Estimating Costs for Technologies

Most of the cost assessment for each technology comes directly from teardown analysis, so the agencies are largely aligned when it comes to costs. Because this methodology is widely acknowledged as the most reliable (e.g., NRC 2015), we find no reason to second-guess this approach and believe that the agencies have largely attributed direct costs appropriately, with one clear exception being the discrepancies in costs for lightweighting. However, translating those costs into price increases for consumers was done via two very different methods, which merits further discussion. We believe that the agencies should both be using indirect cost multipliers (ICM) in their primary analysis to assess indirect costs, as they did for the 2017-2025 FRM.

1. RPE and ICM

While the cost of a given technology may have a very clear, direct cost to the vehicle, the price paid by a customer purchasing a vehicle with that technology will depend on a significant number of factors, including additional engineering costs associated with developing and implementing new technologies, potential ramifications for a warranty, changes to marketing strategy, capital depreciation and amortization related to integrating the technology, and profit for both the dealer and manufacturer. Some of these factors are dependent upon the specifics of a technology, while others may be attributed to fixed costs for a manufacturer.

Historically, a common way of approaching this problem is to use a single value for all technologies on a vehicle—this treats each technology in an average way and is known as a Retail Price Equivalent (RPE). Clearly because each technology is unique in terms of the additional overhead costs associated with its adoption, this is a gross oversimplification.

An alternative approach is to use an Indirect Cost Multiplier (ICM). In this case, each technology is credited with its own unique multiplier designed to better capture the specific costs. As the National Research Council noted in its report, "this approach seems clearly superior to assuming identical impacts for all technologies" (NRC 2015, p. 248). Ensuring its accuracy is a painstaking process, but EPA used two separate methods to arrive at a consistent approach to estimating ICMs for the automotive technologies used the rulemaking (Helfand and Sherwood 2009), and ICMs were, in fact, used in the primary analysis for both agencies in the 2017-2025 FRM.

a) NRC Assessment of ICM v. RPE

While the agencies both adopted the ICM in the 2017-2025 FRM, NHTSA has reverted to using the oversimplified RPE approach. In defending this about-face, NHTSA relies exclusively on the judgment of the National Research Council (NRC), who agreed with the superiority of the ICM approach but maintained concerns about the empirical data surrounding the approach. However, in their assessment of the empirical evidence, the NRC seems to overlook critical aspects of the ICM approach, which serves to undermine their skepticism.

The RPE has tracked historically at 1.5, with very little variation over decades (NHTSA 2012, p. 785). While EPA explicitly examined the increase in costs related to specific technologies and how those would change over time in determining specific ICM values, there is no similar historical record for the ICM approach. The NRC assumes that over the long-term and across all technologies, the ICM should average out to be equivalent to the RPE. While this is not exactly true (for example, overhead costs like health insurance are included in the RPE but not the ICM), it is a reasonable way to ensure that the ICM approach is largely consistent with the oversimplified RPE approach. To respond to this, the agencies provided analysis to the committee that show how over the lifetime of the rule (2017-2025), the average RPE is equal to 1.51, despite a range of ICM values of 1.19 for the least complex technology in the long-term to 1.77 for the most complex in the near-term (EPA 2014). Because most of the ICM values applied are less than 1.5, the NRC committee found this to be incongruous, dismissing the result (NRC 2015, p. 7-7). However, this just underlies that they did not fully understand EPA's methodology.

The ICM is applied to the direct cost in year one of the cycle—this means that while the direct costs may decrease over the product cycle due to learning, the indirect non-warranty costs are unchanged, effectively increasing the value of the ICM. This is illustrated well in the derivation of the ICM used for turbocharged, downsized engines (NHTSA 2012, Table VII-7), where the effective multiplier increases by 12 percent over the near-term part of the product cycle, from 0.387 to 0.432. This consideration is especially important with novel technologies that may undergo rapid reductions in direct costs due to learning. Had the NRC committee recognized this aspect of the agencies' application of the ICM, they may not have dismissed the agencies' evidence for the ICM averaging out to the RPE so readily. That the ICM approach in the long-term averages out to be consistent with the RPE while enabling much greater detail in the near-term is strong evidence for the merits of this approach.

b) Impact of the RPE Approach o n NHTSA Estimates of Cost

The RPE approach significantly overestimates the long-term costs of individual technologies, treating technologies that are well-integrated into the production process equally to those that require additional person-hours devoted to development and integration. The agencies have gone through rigorous peer review to create an approach that better represents the way in which indirect costs would be related to specific technologies. Furthermore, the agencies have shown in the long-term that this more nuanced approach is consistent with the historical average indirect costs.

We recommend that the agencies continue to use the ICM approach in their primary modeling, as they did in the FRM. While it may be appropriate to use the more conservative RPE approach as a sensitivity case, it is less adept at replicating the more rapid product development process that these standards help drive. Enlisting the ICM approach in its primary analysis would reduce the estimated cost of compliance in 2025 under NHTSA's Volpe model by $205.

B. Technology Effectiveness

Differences in technology effectiveness significantly alter the technology pathways to compliance "chosen" by either the OMEGA or Volpe models. In this section we outline differences in technology characterization between the two agencies and suggest ways to harmonize these competing assessments.

1. Performance Neutrality

In the 2012-2016 and 2017-2025 rulemakings, it was noted by the agencies that compliance with fuel economy regulation should not degrade performance attributes. In our whitepaper, we refer to this as "performance neutrality" (Cooke 2016a). Technologies can be used to both enhance performance and reduce fuel usage, but most often employing such technology is done with a trade-off towards one or the other. In order to ensure a "maximum feasible" standard, "performance neutrality" dictates that fuel economy gains of a technology are maximized while minimizing the change in performance.

In its Autonomie modeling, ANL did not hold performance constant, as is evident in the modeling data provided in the TAR (ANL 2016). This means that for many technologies, performance characteristics of the vehicle are improved, often *at the expense of fuel economy*. This is most pronounced in the cases of transmissions with a higher number of speeds and mass reduction less than 10 percent. In the case of transmissions, the wider gear ratio spread results in improved acceleration, as noted in the TAR; however, transmissions are designed in mind to work with a specific powertrain, and manufacturers would be able to further downsize an engine, for example, to result in equivalent acceleration with a wide-gear transmission. Similarly, in applying mass reduction less than 10 percent, there is no assumption of matching engine performance to the new weight, which results in tremendous improvements in acceleration.

Using our analysis of the trade-off between performance and fuel economy (Cooke 2016a), we have tried to prorate the fuel consumption reductions of these technologies in the Volpe model. This results in improved fuel consumption reductions at a reduced cost. However, in the proposed rulemaking, NHTSA should seek to maintain performance neutrality as much as possible through the actual modeling results, as they have for mass reduction of 10 percent or greater (MR3, MR4, and MR5). Doing so would reduce NHTSA compliance cost estimates for 2025 by approximately $233.

2. Continuously Variable Transmissions

One of the most significant technology changes between the FRM and the TAR is related to continuously variable transmissions (CVTs). The agencies note that "internal losses in current CVTs have been much reduced and ratio spans have increased from their predecessors, leading to increased effectiveness and further adoption rates in the fleet, particularly in the smaller car segments. The new CVT's also tend to give the best effectiveness for their cost." (TAR, p. 5-43) This makes them a strong technology moving forward, and while different manufacturers may be utilizing them at different rates today, there are clear benefits to them as an enabling technology.

EPA, in its assessment of transmissions, recognizes that CVTs, dual-clutch transmissions (DCTs), and automatic transmissions (ATs) with a wide gear ratio all can contribute significantly to reducing fuel usage from light-duty vehicles, both today and in the future (up to 10 to 15 percent compared to today's transmissions). EPA also "expects that similar gains in efficiency can be made, independent of the transmission type" (TAR, p. 5-296), choosing to aggregate transmission technologies into five categories (null, TRX11, TRX12, TRX21, and TRX22) based on the gear spread and internal mechanical efficiency of the gearbox, ignoring the specific architecture of the transmission—in this case, current generation CVTs are categorized with six-speed automatic transmissions (TRX11). By widening the ratio spread of the CVT (from 6-7.3 up to 8-8.5) and improving the efficiency of the CVT (from 85 percent efficient up to 90-94 percent), EPA estimates that CVTs could improve in the future to a performance equivalent to the ZF 8-speed automatic transmission (benchmarked to TRX21) (TAR, p. 5-299).

NHTSA does not allow for any future improvements to CVTs in its Volpe modeling. Furthermore, it also does not allow the model to move from a CVT to an AT or DCT. This means that according to the Volpe model, any vehicles with a CVT in the baseline fleet will not see improvements in efficiency related to the transmission over its lifetime. This is clearly an incorrect assumption—regardless of transmission type, one should expect based on current trends and product plans for vehicles to continue to improve in transmission efficiency.

To assess the impact of this flawed approach, we have ascribed all non-hybrid CVT transmissions to AT6s in the baseline fleet and allowed them to improve up to an AT8 level (skipping the AT8P technology package because that would correspond to the TRX22). In our estimate, this is equivalent to EPA's approach, which we believe better represents the reality of CVTs in the fleet and future possibilities. As can be seen in Table 1, this allows for a reduction in costs of $24, as manufacturers can now improve the transmission of vehicles with CVTs to comply with regulations instead of having to apply more expensive technologies.

We recommend that NHTSA ensure there is a CVTP (CVT "plus") technology option for 2020 and beyond that recognizes the future improvements to CVTs expected in the fleet, as it already does with AT6P and AT8P. This approach would be concurrent with EPA's assumptions. EPA is planning on extensive benchmarking of CVTs for the Proposed Determination, so NHTSA should work to incorporate this new data into NHTSA's own Proposed Rulemaking.

3. High Compression Ratio and Atkinson Cycle Engines

Mazda's SkyActiv family of engines uses a high compression ratio (HCR) to generate a significant amount of power in an efficient way, comparable to some turbodownsizing applications. Part of this efficiency gain comes from essentially running in an Atkinson cycle at times. Toyota and Hyundai-Kia have also been employing engines that operate part-time over an Atkinson cycle. While these engines had previously only been deployed in hybrid-electric vehicles, their recent deployment in conventional powertrains is one of the major unforeseen developments in the FRM that has been recognized in the TAR.

However, it is very clear that the two agencies did not devote equal energy and resources into estimating the impacts of these engines, nor their viability for broader deployment—this has a significant impact on how these engines are incorporated into the final compliance packages for 2025. EPA spent a significant amount of work benchmarking the 2.0L SkyActiv engine as well as futuring it, modeling it with both higher compression ratios and low-pressure EGR as well as paired with cylinder deactivation and a transmission with a wider gear spread ratio (TAR, p. 5-270). NHTSA does not have a significant amount of data on HCR and Atkinson-cycle engines. NHTSA based the engine map used in Autonomie simulation on EPA's benchmarking of the 2.0L SkyActiv, but the primary use of Atkinson cycle engines in NHTSA's analysis is for hybrid-electric vehicles (TAR, p. 5-511). Furthermore, there is no evidence of NHTSA having modeled a more advanced HCR engine, which we discuss further in Section II.B.3.b.

a) Benchmarking the OMEGA and Volpe Model Inputs Against Current HCR Technology

When comparing the input of the Volpe and OMEGA models, the biggest discrepancy appears to be in the "future" HCR engine effectiveness; however, there are some small discrepancies even within modeling of the base level of HCR technology. To assess which model better represents the real application of even the base HCR technology, we can compare the model results to the benchmarked Mazda3 with a 2.0L engine.

To emulate the OMEGA model, we use the Lumped Parameter Model (LPM)—while no longer a physically accurate model, it has been calibrated to the results from the ALPHA model and acts as the "calculator" that determines effectiveness of the OMEGA simulations. In this case, we build up the baseline with the same technologies that are available on the Mazda3 in the baseline fleet: engine friction reduction level 2 (EFR2), dual-cam phasing (DVVT-DCP), 6-speed automatic transmission (TRX11 = 6AT, HEG1 (7%), aggressive shift logic, and early torque converter lockup), electrically assisted power steering, stoichiometric gasoline direct injection (SGDI), and Atkinson level 2 (ATK2 w/o cooled EGR). We can apply this technology package to two different Small Cars representing two Mazda3 trim levels (Table 2).

TABLE 2. Comparison of results from the OMEGA and Volpe models for the 2014 Mazda3 and actual test fuel economies for two trim levels.

(a) Mazda3	Lab MPG	OMEGA	Volpe
4-door	46.0	43.0	42.6
5-door	45.1	41.6	41.2

Engine: 2.0L (155 hp, 150 ft-lbs. max torque)
Vehicle characteristics:
4-door: Test weight = 3125 lbs.; road load = 9.80666667
5-door: Test weight = 3250 lbs.; road load = 10.2

In the case of the Volpe model, there is no "null vehicle" in the baseline data set, so it is instead appropriate to apply technologies to low-technology vehicles similar in performance to the Mazda3 and Mazda CX-5. For the former, we choose two different small cars, the baseline trim of both the Dodge Dart and Chevy Cruze. While the lab-test fuel economies of these two vary slightly (36.3 mpg and 35.1 mpg, respectively), they both have an equivalent baseline technology package: double overhead cam engine (DOHC), variable valve timing (VVT), electrically-assisted power steering, engine friction reduction level 1, and a six-speed automatic transmission. To this baseline package, we can follow the Volpe technology pathway to end up with a Mazda3 vehicle package, with improvements to the engine (>VVL>SGDI>HCR; >EFR2) and vehicle (MR1>MR2>MR3).

In both cases, the agencies fall essentially in line, though well short of the measured Mazda3 fuel economy. This may be indicative of other performance characteristics not captured by either model, or it could indicate that the level of improvement of which today's high-compression ratio engine are capable is being undervalued by the agencies.

b) Comparing the OMEGA and Volpe Model Inputs for Future HCR Technology

More striking, however, is the drastic deviation that exists between the agencies when it comes to future improvements to HCR technology. There are three HCR packages examined by the agencies: 1) current HCR technology (labeled ATK2 w/o CEGR by EPA and HCR by NHTSA), 2) future HCR with a higher compression ratio (14:1) and cooled EGR (ATK2 w/CEGR [EPA], or HCRP [NHTSA]), and 3) adding cylinder deactivation to the future HCR engine (ATK2 w/CEGR + DEAC [EPA], or HCR2 [NHTSA]).

To assess the future potential of HCR engines, EPA attempted to future the current Atkinson engine using GT-Power (Lee, Schenk, and McDonald 2016). Additionally, EPA is working on hardware testing of this engine package. This work thus far has shown this pathway to be a promising alternative way to match the levels of improvement from a 27-bar BMEP turbocharged engine. According to the LPM, increasing the compression ratio and adding cooled EGR could achieve about a 10 percent improvement over today's HCR engines. Combining this with cylinder deactivation would achieve an addition 2 to 3 percent improvement.

NHTSA did not model any future improvements in HCR. The HCRP technology package is omitted from the Volpe model inputs. The HCR2 package is nominally consistent with EPA's results, with a 3 percent improvement applied in every class. However, this was not backed up by any modeling runs or other data included in the docket materials—rather, it appears to be an estimate or placeholder.

Given the significantly different levels of attention paid to this technology, it is prudent to assume that the robust body of evidence EPA is putting together based on benchmarking and modeling data is a reasonable assessment of the technology's potential. Therefore, we can attempt to correct the Volpe model's inputs by replacing the incremental fuel consumption reduction with that of the EPA model, accounting of course for the respective synergies as well. Because no costs were previously included for the omitted HCRP technology, we have included an incremental cost in line with CEGR1; this is reasonably consistent with the EPA estimate of this technology, though this is merely a placeholder since we anticipate more robust data to be available for the proposal. Costs for HCR2 are unchanged and equal to the cost for adding cylinder deactivation.

c) Impact of HCR Effectiveness Adjustments on Volpe Model

The addition of HCRP to the Volpe technology list should have a small but measurable impact on the costs of meeting the standards, but the difference is not as substantial as one would expect due to restrictions of the Volpe model, which will be discussed below in Section II.C.1 (-$1) (Table 1). Moreover, in spite of improving the HCR2 effectiveness and its very low cost, the model continued to output zero percent adoption of the technology, suggesting that there may be even further reductions from HCR engines possible, but that the Volpe pathway model is acting in a way that restricts the adoption of the technology despite its cost-effectiveness. Regardless, it remains clear that NHTSA should reassess its fuel reduction potential for HCRP and HCR2 and more carefully align with EPA's modeling of this technology.

4. Cylinder Deactivation

Cylinder deactivation is a technology that has been around for decades, but recent advances have significantly increased the potential application of the technology to smaller engines (Isenstadt, German, and Dorobantu 2016). Neither agency has assessed the potential for "rolling" cylinder deactivation, which is critical for moving down to 3-

cylinder applications, but both agencies purported to include the benefits of cylinder deactivation in engines as small as I4s. However, there is a significant disparity between those assessments, and it is unclear the reasons for this disagreement.

EPA benchmarked its cylinder deactivation using the 2014 Chevy Silverado, with a 4.3L V6 (Stuhldreher 2016). This engine uses continuously variable valve timing (CVVT) and gasoline direct injection (GDI). In this study, EPA found that cylinder deactivation was active less than half the time during each test cycle but improved the thermal efficiency of the engine at those points by as much as 11 percent. However, when implementing this into OMEGA, the improvements of cylinder deactivation are even less than valve lift, of the order of 2-3 percent. While it is true that fixed cylinder deactivation is most effective for naturally-aspirated, larger engines, this still appears a conservative estimate: the National Research Council (NRC) noted an improvement of 4.5-5.5 percent for V6-V8 applications, relative to cam phasing (NRC 2015); the International Council for Clean Transportation found improvements for fixed cylinder deactivation up to 6.5 percent (Isenstadt, German, and Dorobantu 2016); and EPA themselves noted improvements of 3 to 7 percent (TAR p. 5-281). In fact, while the agencies note a synergy with GDI and cylinder deactivation (TAR p. 5-21), the incremental effectiveness of the technology in OMEGA is not significantly different with or without GDI (no more than a few tenths of a percent).

On the other hand, NHTSA seems to have significantly overestimated the potential for cylinder deactivation, finding incremental effectiveness of 5 to 9 percent additional fuel consumption beyond an engine with VVT, variable valve lift (VVL), and SGDI. This is surprisingly high, since VVL significantly reduces the pumping losses that cylinder deactivation could further reduce—in fact, the NRC report commissioned by NHTSA found a mere 0.7 percent improvement for V6 engines (compared to up to 9 percent), and in the case of pick-up trucks, the 5 percent incremental effectiveness nearly exceeds the NRC's entire estimate for cylinder deactivation relative to a baseline engine with neither VVT nor VVL. Beyond the magnitude of the improvement, there are some surprising comparative results as well: for example, while fixed cylinder deactivation is noted to be more effective for larger engines, its effectiveness for midsize vehicles in the Volpe model (midsize car and small and midsize SUVs) is much larger than its effectiveness for pick-up trucks.

It is likely that upon assessing the potential for dynamic cylinder deactivation for the proposal that the agencies will reevaluate the potential of cylinder deactivation. We recommend that, given how far apart the assessments of the agencies were in the TAR, they work more closely moving forward to ensure a similar level of expected improvement for this technology.

In the meantime, to more adequately assess the costs of meeting future vehicle standards, we have based the effectiveness of cylinder deactivation in the Volpe model by comparing the fuel economies achieved by EPA LPM for a vehicle with a 6-speed automatic transmission and no road load reduction, powered by an engine with low friction lubrication, VVT, and SGDI both with and without cylinder deactivation. While this does not cover the full spectrum of engines utilizing this technology, the relative synergy factors within the Volpe model should largely take care of these relative combinations.

The effect of this approximation results in a similar effectiveness to that of EPA. As mentioned above, this is likely conservative, but it is more representative of the expected improvement from the fixed cylinder deactivation technology employed by the agencies in their modeling. We have compensated the incremental level of improvement for turbodownsizing level 1 to ensure that the total performance of that technology package is not reduced. The resulting impact on the NHTSA compliance cost estimate for 2025 is an increase of $47.

C. Modeling Assumptions

In addition to considerable differences with technology effectiveness, the modeling tools used by the agencies are drastically different. While some of these are fundamental differences in approach, such as the limitations of a pathway approach when it comes to application of technology packages or the restrictions represented in Volpe to attempt to replicate industry design cycles, other differences exist that have a significant impact on the future costs of compliance and do not necessarily represent a reasonable assessment of the industry moving forward.

1. High Compression Ratio Engines Limited to Current Manufacturers

As mentioned above, there is a significant difference between the two agencies in their approach to high-compression ratio engines, and these differences are not limited to the assessment of the technology itself. NHTSA has restricted the application of this technology only to manufacturers who have already produced engines with this technology (Hyundai-Kia, Mazda, and Toyota). This limit is purely artificial and makes assumptions about future engine deployments unique to this technology and for which the agencies have articulated no basis.

Beyond merely being unjustified, there is also evidence that this restriction is actually in conflict with industry deployment. For example, Nissan is excluded from NHTSA's list of manufacturers deploying HCR engines, but they have already debuted an engine outside the United States that employs the Miller cycle with a 13:1 compression ratio (the HR12DDR engine, available in the Nissan Note [Versa])—it is not a large leap to suppose this or a similar engine could wind up in U.S. vehicles in the future (Nissan n.d.). Audi as well is utilizing the Miller cycle in its next generation A4—the EA888 engine will use a turbocharger (instead of the more common supercharger), but the principal behind the engine and use of the Miller cycle is more in line with the "rightsizing" approach of the Mazda SkyActiv platform instead of the "downsizing" approach of the turbodownsizing pathway (Birch 2015). Finally, given that manufacturers Honda (Kadota, et al. 2009), Nissan (Stewart 2016), and Volkswagen (Howard 2015) and engineering firms FEV (Wittek n.d.) and Envera (Envera n.d.) have all announced variable compression ratio engines, which at the maximum end of the range approach the same high compression used in the SkyActiv engines benchmarked by the agencies, it is clear that this technology could be deployed by more than the three manufacturers for which the Volpe model has limited the technology's application in modeling for the TAR.

A further restriction employed on these engines was that they were limited to 4-cylinder engines; however, Toyota is utilizing the Atkinson cycle in the 3.5L V6 in its Toyota Tacoma pickup (Williams 2015), indicating that this technology can be deployed in larger engines as well. Therefore, we have removed this restriction for all engines except for ultra-high performing engines (e.g., those for exotic sports cars) and those which are already supercharged or turbocharged.

By removing both restrictions on the HCR engine and after correcting NHTSA's underestimate of its potential, it is able to be much more widely deployed by manufacturers to reduce their compliance burden, even within the structured pathway approach employed by Volpe. However, the net impact of this is minimal ($1 decrease in estimated compliance costs) with the default HCR effectiveness within the Volpe model.

2. ZEV Compliance

California's Zero Emission Vehicle (ZEV) policy is the primary driver of electrification today. This policy, adopted by nine other states and the District of Columbia, ensures that a certain fraction of vehicles sold in these regions will be propelled predominantly by electricity. While EPA recognized that manufacturers would be obligated to comply with this policy in the future, NHTSA chose to ignore this reality. This error serves to create a baseline vehicle fleet that is inconsistent with policies on the books today and therefore does not adequately represent the status quo.

a) Statutory Obligations Do Not Exclude Adoption of ZEV Policy in Baseline

In choosing to exclude ZEV compliance from the baseline, NHTSA has cited its statutory obligation under 49 U.S. Code § 32902 (h), where it states that in considering fuel economy regulations, the Secretary of Transportation "may not consider the fuel economy of dedicated [alternative fuel] automobiles" and "shall consider dual fueled automobiles to be operated only on gasoline or diesel fuel". However, this is relevant only for standard-setting runs, not for projecting real world compliance with the standards.

In the 2017-2025 rulemaking, while NHTSA eliminated the application of EV technology in its "standard setting" runs, including going so far as to turn the projected sales of the Tesla Roadster, Nissan Leaf, and Chevy Volt into internal combustion engine vehicles that had to meet the same standards, they allowed EVs to remain in the "real world" runs, reflecting the obvious reality.

Similarly, in its analysis for the TAR NHTSA has again included future projected sales of electric vehicles like the Fiat 500e, Toyota Prius Plug-in, etc. It is not clear at all why NHTSA acknowledges it can include these vehicle sales in its baseline while not taking the additional step to ensure that these sales are consistent with the application of binding public policy. While the application of EV technology may not be considered when setting the standard according to statute, that statute has no bearing on projecting real world compliance with the regulations, which certainly should be reflective of current policy.

b) *Modeling ZEV Compliance*

In modeling ZEV compliance, we have taken a similar approach to that of EPA, balancing mainly the sales of PHEVs and BEVs, while also including increasing sales of hydrogen fuel cell vehicles (expected predominantly in California). We did use slightly different assumptions than the agency when modeling compliance: 1) We allowed for credit-trading between manufacturers, which meant that Tesla generated credits that other manufacturers then used to comply with the regulation; 2) based on future product announcements, it appears that manufacturers are more focused on increasing the offerings of PHEV30 vehicles and BEVs rather than the Volt-like PHEV50, so we utilized the PHEV30 for all manufacturers except General Motors; and 3) where possible, we focused on increasing the sales of vehicles that already exist in the fleet. In all cases, we modeled the increase in ZEVs to the fleet by shifting sales of comparable vehicles in the baseline to those with electric powertrains to try to ensure a fleet of similar size characteristics.

In practical terms, these small differences with EPA result in about the same number of EVs on the road in 2025 as EPA's analysis (3.2 percent compared to 3.8) but one that has a slightly higher fraction of pure electric vehicles (2.5 percent compared to 2.1 percent). It also, as one would expect, significantly reduces the additional costs of complying with federal regulations with many more advanced technology vehicles already present in the baseline due to existing policy.

We recommend that both agencies incorporate compliance with ZEV in the baseline fleet, harmonizing the modeling of that compliance as much as possible despite the differences in the Volpe and OMEGA models.

3. 2014 v. 2015 Baseline

a) *Baseline Performance*

The choice of the baseline reference fleet is significant. First and foremost, it serves as the baseline performance reference. As we've written previously (Cooke 2016a), this has significant ramifications—because performance (e.g. 0-60 mph times) has improved so significantly compared to the 2010 baseline fleet when these rules were developed, particularly for trucks, even just an updated reference of 2014 results in increasing the 2025 projected costs of compliance by hundreds of dollars because manufacturers have chosen to use technologies that could have been used solely to reduce fuel consumption and used them, in part, to improve performance. Our assessment suggests these additional costs could range from between \$300 and \$500.[5]

Choosing a more recent baseline only further serves to "bake in" this inefficient use of technology, ascribing costs that should be borne by manufacturers as a trade-off instead as a direct cost of regulation. Were this to continue unchecked, one could envision in the future modeling a fleet of vehicles with extremely powerful engines (e.g., Hellcats) already utilizing the most cost-effective technologies for power, thereby forcing the model to choose more expensive, more advanced technologies while not ascribing any of this cost burden to manufacturers. We continue to believe that the increases in costs that are inevitable from this inefficient use of technology should be deducted from the costs of regulation—if manufacturers wish to increase the performance of vehicles instead of reduce fuel use, that is a choice that will force them to climb farther up the technology tree, but that choice is not the responsibility of regulators to consider.

In modeling technology effectiveness and use, the agencies should use 2010 levels of performance as the baseline. Then, the agencies could "build up" the 2010 vehicle fleet to match the most recent, complete fleet data (e.g., 2014), using engineering judgment as is done today to assess what technologies are applied to the vehicle. In this case, however, this may require fractional technology application to match fuel economies from the modeled 2010 vehicle to the most current vehicle, or omitting technologies altogether because they were not needed to achieve the level of fuel economy on the current vehicle (signifying the amount of foregone gain due to performance creep). Vehicles not yet present in the 2010 fleet could be added, and those no longer present appropriately "retired", but this would ensure that the fleet performance most closely represents that of the 2010 fleet.

An alternative approach to eliminate costs related to performance creep would be similar to what we modeled in our paper (Cooke 2016a)—the agencies could look at the improved performance of the baseline fleet relative to the 2010 fleet and discount the costs appropriately to reflect foregone reductions in fuel consumption, using the emphasis on reducing fuel consumption as the basis for accrued technology costs. This would not wholly account for the cost increase incurred, but it would be simpler to implement.

b) *Baseline Technology Assessment*

As noted above, we have concerns about updating the baseline due to performance creep and its ensuing effect on the costs of compliance with regulations. At the same time, we do recognize that it is important for the agencies to assess the technologies already available in the fleet today. The significant developments that have occurred over just the few years since these rules were finalized show how technology available

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[5] The analysis in our whitepaper showed an increase in cost of \$500 for the 2014 baseline based on performance increases from the 2010 baseline. However, costs in the TAR for future compliance have come down by approximately one-third, so it is likely that the costs incurred for this performance improvement would be similarly reduced.

to the industry can change rapidly, and it is important to capture the most recent picture possible.

The two agencies differ in their approach in the TAR—EPA has chosen to include the most recent, finalized manufacturing data, while NHTSA has used more recent, but preliminary data. While we agree with NHTSA that future product offerings will be more similar to vehicles in 2015 than 2014, we do not agree with the decision to use preliminary data—such data is based on product plans that are often delayed or altered, meaning that the technology in use by the fleet in a given year may not actually be as great as the preliminary plans would suggest.

This concern builds upon manufacturers' inefficient use of technologies to-date, wherein improvements will be made to a vehicle, but, as several manufacturers noted to the National Research Council, "vehicle performance [will] continue to be increased" (NRC 2015, p. 2-52). The more technology is included as-implemented in the fleet, even if part of it goes to performance, the less technology is available to comply with the regulation. Thus, including vehicles that end up not even being included for sale in a given model year needlessly eliminates technologies yet-to-be-applied in a way that forces the costs of a manufacturers' choice to forego fuel consumption reduction to be borne by the regulation.

We recommend that the agencies model the baseline fleet on the most recent model year for which there are finalized sales (accounting of course for any changes in performance, as noted above).

c) Additional Notes on Baseline Fleet Assumptions

There were a few errors in "engineering judgment" applied to the agencies' baseline fleets. To our knowledge, they characterize simple mistakes and are not indicative of broader problems with the methodologies used.

Issues with 2015 baseline characterization in the Volpe model:

- The AWD Tesla Model S is characterized as an SUV. This may have been done to account for the Tesla Model X, which was available at the end of 2015, but in doing so it ignores the D (dual) variants of the S.
- Tesla's sales figures also do not delineate between any of the different range options for the Model S, which will affect NHTSA's ability to appropriately model ZEV credits within the Volpe model.
- Sales projections for the RWD Tesla Model S appear to be based on projected sales of the Tesla Model 3. This vehicle will have a substantially different footprint than the S, which will affect future compliance. No similar such approximation was made for the Chevy Bolt (which could have at least been represented by the Spark EV), but this just serves to underscore why it's critical that NHTSA include ZEV compliance in its baseline.

- The Nissan Rogue Select does not use the same transmission as the Nissan Rogue—the Rogue Select uses the outdated CVT found on the 2013 model of the Nissan Rogue, which is exactly what the Rogue Select is. It seems curious that NHTSA would include in its 2015 baseline a 2013 vehicle just because Nissan rebadged it, particularly when this was temporary as Nissan ramped up production of the redesigned version (they've finally discontinued the Rogue Select for the 2016 model year). All future sales of the Rogue Select past 2015 should be zeroed out and ascribed to the Rogue.

Issues with 2014 baseline characterization in the OMEGA model:

- EPA created a number of "dummy" vehicles in order to comply with ZEV. Since in many of these cases this is based on product announcements in order to gauge information about vehicle class and size, it would be helpful for transparency if the agency would label these vehicles accordingly (e.g., Chrysler Pacifica PHEV). This would help delineate between vehicles that are actually on the road but were not available in 2014 (e.g., Volkswagen e-Golf) and vehicles that are anticipated in order to comply with ZEV. This is unlikely to have a major effect on compliance, since no matter the footprint electric vehicles far exceed the current targets for 2025, but it would help in assessing how representative the baseline fleet is as a future projection.

D. Impacts on Cost assessment of 2025 Standards

Taken in aggregate, the impacts of these results are significant. While downgrading the effectiveness of cylinder deactivation results in increased compliance costs, on net the effect of these changes is to significantly reduce the real world impacts of these regulations. Our analysis shows that complying with the rule in 2025 would be reduced by $480 compared to NHTSA's original assessment (Table 1). These costs are nearly identical to those of EPA and are lower than originally assessed by either agency in the 2017-2025 FRM.

III. Market Trends

The central goal of the TAR is to assess the changes that have occurred in the industry since the FRM. Inclusive of the attributes under review are the fleet mix (cars v. trucks), consumer acceptance, consumer benefits, and the market penetration of fuel efficient technologies. Here we describe evidence relating to those aspects of the TAR and the impact it could have on future proposed regulations.

A. Fleet Mix

Outside of recent rises in vehicle miles traveled, which are also outside the scope of this rulemaking, the most significant factor in the effectiveness of these regulations to reduce national oil consumption and greenhouse gas emissions is the mix of vehicles bought by consumers. Because the agencies have constructed an attribute-based standard that allows for larger, more inefficient vehicles to meet a lower target, the fleet targets are responsive to the choices made by consumers.

1. Impacts on Benefits of Rule

When the rules were finalized, it was estimated that the new vehicle fleet would achieve (according to laboratory tests) 163 g CO_2e/mi. in 2025, or about 47 mpg under CAFE. However, those rules were based on a fleet where nearly two-thirds of the vehicles would be considered cars under the regulation. Today, the new light-duty fleet is nearing equal sales of cars and trucks, as defined in statute. This results in significantly more emissions and fuel use from the fleet under the current rules, as noted in the TAR: 175 g CO_2e/mi. under EPA's regulations and 46 mpg under CAFE.

While the benefits of the rule remain largely intact under the assumption that consumers would have bought this mix of vehicles regardless of the regulations, the current trend in vehicle sales serves to significantly reduce the net benefits of the rule—we estimate that the U.S. light-duty fleet will emit more than 100 million metric tons CO_2-equivalent additional emissions in 2040 (UCS 2016a).

Under the current regulatory structure, there is little EPA or NHTSA can do to control the mix shift; therefore, it is critical that the agencies exercise their authority to ensure that the rules remain focused on what is maximally feasible in this time period, forcing technology into the fleet to obtain the largest reductions within this constraint.

2. Manufacturers Taking Advantage of Fleet Mix Shift as Loophole

Not all impacts of the mix shift are the result of consumer preference—manufacturers have a regulatory incentive to push for increasing sales of larger vehicles in addition to a profit motive (since the profit margin on trucks and SUVs is larger than on sedans). There is evidence that this is having a distorting effect on the market and could lead to even further reductions in the net benefits of the rule.

a) Footprint Creep

The footprint-based standard, on net, encourages upsizing of vehicles (Whitefoot and Skerlos 2012). While designing the curves the agencies attempted to mitigate this incentive, however, there has been a noticeable trend in increasing footprint (TAR Section 3.1.5). Historical evidence from Japan, as well, shows the unintentional consequences of an attribute standard (Ito and Sallee 2014).

While some of the increase in footprint comes from an overall average shift due to the mix shift, there is evidence that manufacturers are increasing the footprint of vehicles in the redesign process, resulting in lower targets for those vehicles (Beene 2016). While some of this may be attributable to legitimate reasons like increasing passenger space, creating more distinction between models of a similar size class, or increasing safety constraints (since enlarging the crash zone is one of the clearest ways to improve safety outcomes), this is a trend that could have a rather significant impact on the standards and may be indicative of a problem with the footprint curves themselves. We recommend that the agencies look very closely at whether manufacturers are unreasonably increasing the footprint of vehicles and consider reassessing the slope of the defined attribute curves to discourage any such behavior.

b) 2WD v. 4WD Small SUVs

The biggest reason for increasing sales of trucks has been the rapid development of the crossover utility vehicle (Automotive News 2016). The influx of this entire new class of Small SUVs has been the source of a tremendous amount of growth; however, statistically speaking all of the growth in the SUV market over the past five years has come exclusively from the 4WD Small SUVs that are classified as trucks—as a percentage of sales, "car" SUVs (small SUVs without 4WD) and large SUVs (considered as trucks regardless of drivetrain) have remained flat (Cooke 2016b).

This oddity in the market is suggestive that manufacturers could be using the distinct treatment of 2WD and 4WD versions of these vehicles as a compliance tool. The huge difference in standards for a 2WD Small SUV and 4WD Small SUV (e.g., 5 mpg for a footprint of 45 sq. ft.) would certainly provide a motivation for manufacturers to increase the sales of the 4WD model, assuming it meets appropriate clearance requirements to be classified as a truck. Indeed, when one examines the value of credits due to that shift ($340), it is comparable to the additional cost of the 4WD powertrain, ensuring that the manufacturer is making a higher profit margin on the 4WD variant (Attachment A – Cooke 2016b).

Given the regulatory and monetary benefit of selling small SUVs classified as trucks, there is a distinct likelihood for this trend to continue. FCA has already eliminated its small car segment because of the low profits and to help reduce their overall CAFE targets, and its iconic Small SUV, the Jeep Wrangler, is available solely in 4WD, further reducing the number of cars it needs to sell—it is quite likely that other manufacturers could follow suit. Should manufacturers offer Small SUVs exclusively in 4WD, this would further erode the benefits of the rule by 1 percent (Attachment A – Cooke 2016b).

We recommend that the agencies look at ways to close this loophole, including the development of a single curve for cars and trucks. This would also negate the adverse impacts of any shift between cars and SUVs while maintaining the attribute standard.

B. Consumer Acceptance

There has been a rapid increase in the adoption of many fuel consumption reduction technologies, thanks, in part, to strong fuel economy and greenhouse gas emissions standards (EPA 2015). This trend is occurring amid record sales of passenger vehicles (Phillips 2016), suggesting that consumers are responding well to the selection of vehicles driven by the current standards. However, we applaud the agencies for digging deeper into the question of consumer acceptance, given that more and more conventional technologies will continue to move into the mainstream as long as the fuel economy and greenhouse gas emissions standards remain strong.

1. Assessment of Consumer Preference

Due to many consumers' lack of familiarity with the specifics of fuel injection or the mechanical components of a transmission, it is difficult to poll the populace and ascertain their particular feelings about a given vehicle technology. Furthermore, for individual consumers, it is difficult to determine a common reference point. Thus, we think it appropriate that the agencies have used automotive reviewers as a surrogate for consumer feedback. While certain publications may focus on performance attributes that the average consumer may not care about, reviewers' familiarity with the breadth of vehicle choices and general understanding of how a car "should" behave provide a singular expertise that make them especially qualified to assess whether there are any adverse impacts from the technologies being applied under current regulations.

Because the integration of a technology is critical to consumer acceptance, a comprehensive dataset such as RTI International created is important—given the rapid deployment of new technologies, a focus on individual manufacturers' implementation of those technologies could lead to erroneous results. The conclusion that ALL technologies have, on net, more positive than negative reviews should put to rest concerns that consumers would respond negatively to the given technologies.

EPA's peer-reviewed analysis attempting to estimate hidden costs associated with technology makes clear that there is no comprehensive evidence to-date of adverse consumer reaction to any given conventional technologies. Manufacturers are clearly capable of incorporating a wide number of fuel consumption reduction technologies into their vehicle fleet, and it is the process of integrating a technology into a vehicle that is key to its market acceptance, not something intrinsic to that technology.

2. Consumer Choice Modeling

As made clear in TAR section 6.2.2, to date there is no evidence of the predictive capability of consumer choice modeling in the automotive sector. While using behavioral economics to anticipate potential market outcomes is absolutely a fruitful endeavor that can lead to key insights about the function of a given market, it would be inappropriate to use this model in a primary analysis to assess a likely path forward.

The National Research Council study examining the path forward to 2050 used consumer choice modeling to assess possible market transitions to different low-carbon futures (NRC 2013). Notably, included in this analysis was a section devoted to the uncertainties in consumer choice modeling (NRC 2013, Section 5.7). Within this section is a summary of parameters related to consumer choice and valuation and the wide distribution of the values of these parameters in the literature. Especially important as the agencies look to rules beyond 2025, where alternative fuels will play an even larger role in reduction in oil usage and greenhouse gas emissions, is this finding of the committee: "There are dozens of studies providing estimates of the sensitivity of consumers' vehicle choices to price, yet little is known about the price sensitivity of choices among novel technologies. On the vehicle and fuels supply side, there is a great deal of uncertainty about learning rates, scale economies, and firms' aversion to risk. Furthermore, all these factors can and likely will change over a 40-year period" (NRC 2013, p. 125). Not only is there uncertainty about how consumers will respond to technology, but there is uncertainty about how industry will respond, and these responses are likely to vary with time.

Using Monte Carlo analysis, the NRC committee looked at the statistical probability of different "futures" given specific technology constraints and emphases—this analysis serves to illustrate not only that there are "tipping points" needed to be achieved to ensure the transition to a sustainable transportation future, but also that the assumptions underlying any individual modeling run have a distinct effect on its outcome, and the broad range of potential values can lead to drastically different results given the current knowledge base. With such a large degree of uncertainty, it would be folly to base any individual policy on the outcome of such modeling—given the current state of the art, the committee noted, "Empirical knowledge of the barriers to major energy transitions is currently inadequate to make robust assessments of public policies" (NRC 2013, p. 129).

Given that we are at the onset of a transition to a cleaner passenger vehicle fleet and the tremendous amount of uncertainty that surrounds such a technology path, we believe it would be a tremendous mistake for the agencies to employ consumer choice modeling as a primary analytical tool to judge the possible path. "To support effective policy making, a much better understanding of how markets and technology will interact is likely to be highly beneficial" (NRC 2013, p. 127).

C. Consumer Welfare

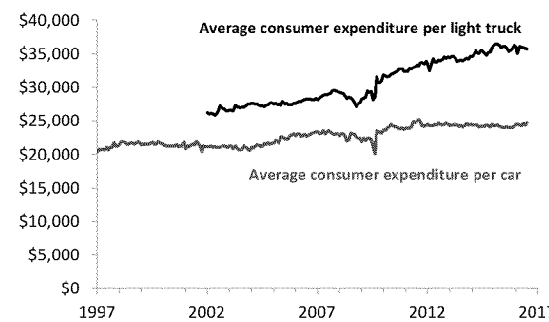
Section 6.5 of the TAR lays out quite clearly how fuel economy standards result in benefits not just for a vehicle's first owner, but also for consumers interested in the used car market. Furthermore, the agencies illustrate that the benefits may actually accrue disproportionately to the most disadvantaged economically, a finding that is consistent with ongoing research into the question of equity and fuel economy policy. In aggregate, we find the agencies' arguments compelling, and wish to comment further on a few pieces of literature in support.

1. Vehicle Price Increase as a Result of Standards?

Because the fuel economy and greenhouse gas standards spur the deployment of technology, the costs of implementing this technology could result in increased costs to the consumer. However, this attribution is often wrought with flaws and overestimated costs that serve to undermine these cost-effective standards.

The agencies rightly point out the numerous flaws in Furth and Kreutzer 2016, resulting in a significant overestimate of the increase in vehicle price attributable to vehicle standards. One point of evidence the agencies did not include in their response was the data underlying the consumer price index for new and used cars (BEA 2016). Instead of examining new car prices, Furth and Kreutzer choose to use new car expenditures and claim that this is the same thing; however, that is clearly an error that incorporates the mix shift, as the agencies noted. In fact, the U.S. Bureau of Economic Analysis maintains average car and light truck prices, and the data shows clearly that both have been slowly increasing over the entire 20 year period, with no statistically significant change in the rate of increase as a result of the standards (though obviously there was a sharp initial decrease in both in 2007-2008 due to the Great Recession) (Figure 1). For this same period, the Consumer Price Index for New Autos is essentially flat, meaning that increases were related either to quality improvements or inflation-related increases in manufacturer costs, neither of which would be considerations related to the fuel economy and greenhouse gas regulations (US BEA 2016).

FIGURE 1. Average consumer expenditure for cars and light trucks over time, indicating that there has been no distinct change in expenditure as a result of recent changes to fuel economy standards.



All of this data is consistent with our own analysis of fuel efficient vehicles. More than 10 percent of the MY2015 fleet would meet fuel economy targets for 2020 or later, the vast majority of which are conventional vehicles (UCS 2015). In our analysis, we examined the differences in retail prices for these vehicles compared to their counterparts in 2010, before the regulations went into effect. We found that the increase in retail price for these 2015 vehicles amounted to an average of just $260 after taking into account inflation, which amounts to less than a year of fuel savings from these same vehicles. Clearly the regulations are not having nearly as severe an impact on the price of vehicles as suggested by the analysis of Furth and Kreutzer.

D. Market Penetration of Electric Vehicles

Vehicle electrification coupled with efforts to reduce the carbon intensity of the electrical grid is a critical strategy for achieving the deep reductions in climate emissions that are needed over the next several decades to avoid the worst consequences of climate change. The biggest impacts of this strategy will occur when large numbers of electric vehicles are adopted into the vehicle fleet. Given that each vehicle is on the road an average of 10-15 years, reaching large penetrations of electric vehicles in the entire U.S. fleet will take time. Current state policies and federal incentives for moving these technologies to market are important for driving drive down technology costs, expanding infrastructure, increasing consumer awareness and experience, and bringing additional vehicle models to market. The greenhouse gas and fuel economy standards are an important compliment to these efforts, but do not require widespread deployment of EVs by themselves.

1. EV Deployment Driven by Existing Policies Must Be Included in the Baseline.

We agree with the conclusions of the agencies that 2025 standards can be largely met with continued advancement and deployment of ICE technology, and will not be a primary driver of electric vehicle deployment. As a result, other state policies and federal incentives remain critical to the early deployment of electrification technologies. Existing policies, especially the Zero Emission Vehicle Program adopted by California and several other states, have been responsible for the deployment of over 400,000 EVs in the US over the past 6 years, and are expected to continue to drive EV deployment throughout the period of the 2017-2025 standards. EPA has rightly included the impact of these policies, including the Zero Emission Vehicle Program, into the baseline vehicle projections used for estimating vehicle technology adoption and costs resulting from the GHG and fuel economy standards. As noted in section II.C.2 of these comments, NHTSA should also include EV deployment resulting from these existing policies in their baseline projections, as this deployment would occur with or without implementation of the fuel economy and GHG standards.

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2. Consumer Interest in EVs Is Strong, But Manufacturer Deployment Is Uneven

Consumer interest in electric vehicle technology is robust, even at this early stage of the market where plug-in hybrids, battery electric, and fuel cell vehicles represent less than 1% of new vehicle sales. A survey conducted by the Union of Concerned Scientists and Consumers Union in California and the Northeast showed the majority of respondents had an interest in EVs and also want to see every automaker offer EVs for sale. In addition to gauging consumer interest, the survey also gathered information on household vehicle needs. The survey found that more than 40% of households could use a plug-in electric vehicle available on the market today to meet their daily driving needs based on access to charging at home, daily driving distance, and towing and hauling needs (UCS 2016b). In addition, the utility of EVs does not appear to be a regional phenomenon. A recent analysis by researchers at MIT concluded that 87% of vehicles driven on a given day could be replaced with a battery electric vehicle available today (Needell 2016). These results were robust across multiple metro areas in the U.S.

While consumer interest and market potential are robust, automaker efforts to deploy electric vehicles has been uneven. California has led the market for EV adoption and is currently at 3% of sales, in part because the state's Zero Emission Vehicle policy. Other states which have adopted the ZEV program, such as those in the Northeast, have had comparatively lower sales.. However, our recent analysis of the electric vehicle market shows that the number of electric vehicle models available in the Northeast is significantly lower than in California (UCS 2016c). In 2015, there were 25 different EV models sold in CA, and at most 14 models were sold in the Northeast states (based on a minimum of 20 vehicle sales). In addition to the number of models, actual availability of cars at the dealership was far lower in the Northeast. For example, in the first 6 months of 2016, Edmunds.com a popular car shopping website, showed on average more than 2,800 electric vehicles for sale in the Oakland/San Francisco area, but only 317 in the Boston area. While many Northeast states have adopted the ZEV program, until 2018 automakers do not have a binding requirement to sell vehicles in those states. This provision of the ZEV program is impacting the level of effort of automakers to bring vehicles to the Northeast market and their efforts to sell them.

Some automakers are demonstrating that with EV technology available today significant sales are possible. For example, BMW introduced its first production plug-in vehicle, the BMW i3, in model year 2014. By the end of 2015, plug-in vehicles accounted for 7 percent of BMW sales in CA and 3 percent nationally. Plug-in EVs represented nearly 6 percent of GMs sales in CA and 5 percent of Nissan sales in 2015. Several other automakers on the other hand sold fewer than 1 percent plug-in vehicles both in CA or nationally. These statistics demonstrate both the feasibility of significantly increasing EV sales as well as the uneven performance of automakers in selling plug-in electric vehicles to date. It also demonstrates the importance of strong policy signals to ensure automakers are developing the technologies needed.

3. Electrification technologies are critical to long -term fuel savings and emissions reductions

The agencies should continue to evaluate the progress of electric vehicle technology and ensure that the full potential of vehicle electrification is captured in future standards The progress in the EV market today in reduced battery, fuel cell, and infrastructure costs, as illustrated by the agencies assessment in the TAR (Section 5.2.4), will continue, driven by federal incentives, state policies, auto industry innovators, and market demands. The continued advances in EV technology will lead to further cost reductions and greater consumer adoption, in addition to more capable vehicles. Multiple battery electric models with 200-mile real world range are expected soon for under $40,000, such as the 238-mile range Chevy Bolt, and the Chevy Volt is evidence of the potential for longer range (50+ mile) plug-in hybrids.

Vehicles powered by clean electricity or hydrogen are critical to the long-term success of stabilizing our climate and current state requirements and incentives have been critical to their development and deployment thus far. Automakers also have benefited from state and federal incentives for vehicles, investments in infrastructure and consumer education helping to increase demand for the vehicles. Going forward, NHTSA and EPA must continue to evaluate the advancement of electrification technologies and ensure they are fully incorporated into future vehicle standard setting. Electrification technologies must be a growing part of the suite of technologies offered to consumers by automakers to ensure we are on track to meet our oil reduction and climate emission goals and protect public health.

IV. Conclusions

We believe that the TAR shows that the standards that were finalized in 2012 are technically feasible and cost-effective and could in fact be stronger to achieve greater emission reductions and fuel savings. The TAR also acknowledges that there are many more technologies available to manufacturers to improve fuel efficiency of the internal combustion engine than were anticipated in the 2012 FRM. Our investigation of ways to reduce NHTSA costs by changing Volpe model inputs shows that the NHTSA costs could be in line with EPA's costs, and lower than the FRM costs, if several appropriate modifications were made to the assumptions and inputs to the modeling. NHTSA should consider these modifications as they move forward with their NPRM for model years 2022-2025. We strongly encourage both agencies to use the most accurate and recently finalized data.

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To: Dave Cooke[DCooke@ucsusa.org]
From: Hula, Aaron
Sent: Tue 1/17/2017 3:01:51 PM
Subject: RE: Copy of EPA CO2/FE Trends Database, excluding production values--first of two emails

Sounds good. Let me know if you have questions and I'm happy to try and dig out an answer.

Aaron

From: Dave Cooke [mailto:DCooke@ucsusa.org]
Sent: Tuesday, January 10, 2017 4:15 PM
To: Hula, Aaron <Hula.Aaron@epa.gov>; Alson, Jeff <alson.jeff@epa.gov>
Subject: RE: Copy of EPA CO2/FE Trends Database, excluding production values--first of two emails

Thanks, Aaron.

From Novation, this is what they've cited as the foundation for their database:

Vehicle Attribute Database

•□□□□□□□□ *The vehicle attribute and performance database used for this assessment was generated, independent of this study, by Novation Analytics.*

•□□□□□□□□ *The MY 2016 Novation Analytics database includes over 1,400 individual vehicle models and subconfigurations offered for sale in the U.S. market. The database combines all vehicle and powertrain specifications with certification test parameters and results, including road load coefficients, equivalent test weights, fuel economy, and tailpipe CO2 emissions.*

•□□□□□□□□ *All data included in the Novation Analytics database were obtained from public sources including manufacturer's consumer and media websites, EPA Verify queries, and certification documents.*

That last bullet is the one that references the VERIFY database. Reading this again, however, it seems to me that 1400 models/powertrain options corresponds to the Fuel Economy Guide/Test Car List Data and not more detailed data, so it may be only that they did not themselves use VERIFY but perhaps spot-checked their analysis with the help of automakers.

Looking more closely at the Test Car List Data and some cert. sheets that I had previously thought had more detail, it actually looks like I was mistaken about there being a discrepancy in the level of detail, so I would have to look into this more with a specific problem in mind before I ask you to do any work. It seems entirely conceivable I am mistaken about the level of subconfiguration detail needed, and it has been awhile since I've really sat down and thought about this.

- Dave

From: Hula, Aaron [mailto:Hula.Aaron@epa.gov]
Sent: Monday, January 09, 2017 9:42 AM
To: Alson, Jeff; Dave Cooke
Subject: RE: Copy of EPA CO2/FE Trends Database, excluding production values--first of two emails

Dave,

Do you have a specific reference from Novation in mind? I was unaware that we had given them any VERIFY data directly. I'm happy to at least try and figure out what exactly we provided, and if it's something we can provide to the public.

You may already know this, but one thing to keep in mind is that there are two separate processes for determining fuel economy data that are a little different. First is the pre model year label process which all manufacturers have to go through before selling vehicles in the US and the second is the post model year GHG/CAFE process. The labeling process is more flexible and requires less data from manufacturers than the GHG/CAFE process. The data on fueleconomy.gov is all label data (even previous years).

In the spring of the calendar year after a model year (so we're coming up on MY 2016 data), manufacturers must submit all of the GHG/CAFE data. The requirements are more strict, and we do get more test data at this point, including footprint data. However I don't think we get data to the resolution you described - accounting for different electrical loads and exact curb weights. We could have a long conversation with the compliance division about what can and can't be aggregated under GHG/CAFE test groupings… but I think I'd need to call in the experts for that conversation.

Both the label and GHG/CAFE data are stored in VERIFY. The Trends data we sent is based on GHG/CAFE data, except for the MY 2016 data which is label data. However, I don't think the Trends data is enough for some of the things you're looking to do (we certainly don't carry A, B, C coefficients or curb weight). EPA does publish a lot of A, B, C coefficients in the Test Car List Data which is on the web. This is not necessarily a complete list, but does have data for many specific vehicle tests.

Hopefully this is somewhat helpful. Like I mentioned, I'm happy to track down what data (if any) we gave to Novation and if it's public if that's helpful.

Aaron

From: Alson, Jeff
Sent: Friday, January 06, 2017 8:10 PM
To: Dave Cooke <DCooke@ucsusa.org>
Cc: Hula, Aaron <Hula.Aaron@epa.gov>
Subject: Re: Copy of EPA CO2/FE Trends Database, excluding production values--first of two emails

Dave, all good questions. I hope the answer is that the public has the same access to the Verify data as industry consultants, but I am ignorant. I am also on leave now and won't be back in the office until February. I am copying Aaron, who is in a better position to respond, as he knows more about the database questions and can also interact with our Compliance Division colleagues.

Aaron, can you look into this?

From: Dave Cooke <DCooke@ucsusa.org>
Sent: Thursday, January 5, 2017 12:31 PM
To: Alson, Jeff
Subject: RE: Copy of EPA CO2/FE Trends Database, excluding production values--first of two emails

Jeff,

Thanks for passing on these documents—I'll take a look and see if I can provide any worthwhile feedback.

I've also been thinking about other data concerns, specifically about data needed for analysis around something like powertrain efficiency or other vehicle-specific, fleetwide analysis. Previously, I have utilized the Fuel Economy Guide (FEG) database (for something like Automaker Rankings). However, that is only an incomplete picture of the fleet, with at most a couple different powertrains, whereas there are innumerable sub-models that share a powertrain but may have different weights or electrical loads that would not show up. Specifically the type of data that I could possibly want in an ideal world is: A, B, and C coast-down coefficients; curb/test weight; individual bin test fuel values; cert levels; etc.

In looking through the data used by Novation, they reference the use of Verify queries. It seems to me that there is a significant difference between the variety of models and details in the FEG database and the Verify database (or, more accurately, the baseline model data accompanying the TAR/TSD, which I assume was grabbed from Verify). Now, I've gone back to cert data before for individual models, the sheets for which are accessible via the OTAQ Document Index System, but those cert documents usually only refer to a couple specific models within a model line, and this data is then extrapolated in some way by the manufacturers to cover each and every vehicle sold. It would also be a time-consuming process to access up to 1000s of vehicles manually like that such that it just doesn't make sense.

One of the reasons why I ask this is while I can look at individual example vehicles, it seems like the ability to do some of this fleet-level analysis is restricted to industry-paid contractors. Is the Verify database restricted to the regulated parties? Or is there actually a way for the public to obtain access as well? Or are there other sources of this data available?

As an example, simply replicating the Novation Analysis seems difficult for someone not affiliated with the industry. If I've mischaracterized this or you can think of a way to obtain data at a level of detail exceeding the FEG database, I'd certainly appreciate it.

Thanks,

- Dave

From: Alson, Jeff [mailto:alson.jeff@epa.gov]
Sent: Wednesday, January 04, 2017 3:36 PM
To: Dave Cooke; Tonachel, Luke; John German; Nic Lutsey; Daniel Becker; John DeCicco; dlgreene@utk.edu; dwhm@uw.edu
Subject: Copy of EPA CO2/FE Trends Database, excluding production values--first of two emails

Last year, EPA received a FOIA request from Georgetown University for the Trends database, in its entirety. EPA determined that we could release most of the data publicly. The one part of the database that we cannot release at this point is the production/sales component, which we realize is a valuable part of the data. EPA is continuing to investigate if it would be possible to release the production data at some point in the future. The database includes data from MY 1975 through preliminary MY 2016. Due to file size, we had to split up the database, so this has the older rows and a second email will have the more recent rows.

The FOIA request and related files should be available on FOIA online in the coming weeks. Since we are sharing this data publicly for the first time, we wanted to share it with a few additional people outside of the agency that are regular users of the Trends report and might find the data useful. We consider this release a bit of a “beta” trial for releasing the data more widely, and would appreciate feedback if parts of the data or documentation are confusing. In addition, we would appreciate knowing if you are considering forwarding the database on to others, so that we can keep track of who has direct access to the database. Please keep in mind that the documentation was developed for EPA, not the general public.

There are a few additional notes that were provided as part of the FOIA:

1) The attached database is an export file from the Trends database, from the database version used to create the 2016 CO_2 and Fuel Economy Trends report. All production/sales data have been removed.

2) The data in the Trends database are based on data submitted by manufacturers for compliance with the GHG and CAFE regulations. However, it does not account for credits and other flexibilities that are part of both regulatory programs. This database alone **cannot** be used to assess regulatory compliance of any manufacturer or vehicle.

3) This database contains preliminary data for MY 2016. The MY 2016 data are subject to change when final values are submitted to EPA.

4) The manufacturer groupings in this data represent current market conditions for all past years for consistency of analysis. For example, Fiat-Chrysler is considered one manufacturer for all years in the report, even though that relationship only occurred a few years ago.

5) All weight data are based on inertia test weight classes and not individual vehicle curb weights, and may not be accurate enough for detailed analysis.

6) Footprint data prior to MY 2011 were aggregated from various sources. Data for MY 2011 on is from manufacturers. Therefore, there may be more uncertainty with the earlier footprint data. Especially in the case of large trucks with many footprint options, footprint data in some cases were aggregated and/or averaged across various configurations and may not be precisely correct for each row of the database.

7) EPA highly recommends reading sections 1 and 10 of the Trends report for more details on the data and its limitations.

If there are any questions about the data please feel free to contact Aaron Hula at hula.aaron@epa.gov or (734) 214-4267, who is now the lead author on the Trends report. Ex. 6 - Personal Privacy

Ex. 6 - Personal Privacy

To: McDonald, Joseph[McDonald.Joseph@epa.gov]
From: Cherry, Jeff
Sent: Mon 5/23/2016 5:52:29 PM
Subject: RE: Auto Alliance presentation to CARB

Joe,

Ex. 5 - Deliberative Process

Best regards,

Jeff

Jeff Cherry
Assessment & Standards Division
US EPA Office of Transportation & Air Quality
National Vehicle Fuels and Emissions Laboratory
2000 Traverwood Drive
Ann Arbor, MI 48105
Voice: 734-214-4371
cherry.jeff@epa.gov

-----Original Message-----
From: McDonald, Joseph
Sent: Thursday, May 19, 2016 12:06 PM
To: Moran, Robin <moran.robin@epa.gov>
Cc: Cherry, Jeff <Cherry.Jeff@epa.gov>; Bolon, Kevin <Bolon.Kevin@epa.gov>; Olechiw, Michael <olechiw.michael@epa.gov>
Subject: Re: Auto Alliance presentation to CARB

Ex. 5 - Deliberative Process

Joseph McDonald
Senior Engineer

U.S. EPA
ORD/NRMRL & OAR/OTAQ
Mail Stop 236
26 W. Martin Luther King Dr.
Cincinnati, OH 45268 USA

Telephone: 513-569-7421
Cellular Telephone: 513-316-2380
E-mail: mcdonald.joseph@epa.gov

> On May 19, 2016, at 11:22 AM, Moran, Robin <moran.robin@epa.gov> wrote:
>
> Team,
>
> This is the full briefing the Auto Alliance presented with their contractor, Novation Analytics, on

Tuesday.
>
> From: McCarthy, Mike@ARB [mailto:michael.mccarthy@arb.ca.gov]
> Sent: Wednesday, May 18, 2016 11:07 AM
> To: Olechiw, Michael <olechiw.michael@epa.gov>; Bolon, Kevin
> <Bolon.Kevin@epa.gov>; james.tamm@dot.gov
> Cc: Moran, Robin <moran.robin@epa.gov>; Barba, Daniel
> <Barba.Daniel@epa.gov>; Kevin.Green@dot.gov
> Subject: FW: Presentation
>
> FYI—share among your teams as needed.

Ex. 5 - Deliberative Process

> From: Greg Pannone [mailto:gpannone@novationanalytics.com]
> Sent: Tuesday, May 17, 2016 2:17 PM
> To: McCarthy, Mike@ARB
> Subject: Presentation
>
>
> Gregory Pannone | President
> novation analytics
> 2851 High Meadow Circle, Suite 160
> Auburn Hills, MI 48326
> M 313.910.3280
> novationanalytics.com<http://novationanalytics.com>
> <Novation_Analytics_Trade_Association_Technical_Briefing_CARB_17may201

> 6_v1.0.key.pdf>

To: Moran, Robin[moran.robin@epa.gov]
From: John German
Sent: Wed 9/14/2016 8:57:58 PM
Subject: Re: 9/22 Hearing

I will focus primarily on technology innovations over the last 5 years, based primarily on the series of technology papers ICCT is publishing in cooperation with suppliers. I will also discuss the problem with using (a) older estimates and (b) assuming technology innovation stops today. Technology is developing so fast that either of these will yield higher cost estimates, not because there is anything wrong with the methods, simply because the latest developments are not included. I might use the best-in-class analysis done by Novation Analytics as an example - for example, their report stated, ""Novation's approach means that the best-in-class technology today would be the average performance of that same technology in 2025." They present this as though current best-in-class technology is the best we can do by 2025. The reality is that the average vehicle in 2025 will be much more efficient that best-in-class technology today.
I will also discuss consumer issues. Two main points. First, there isn't a consumer backlash if the fuel savings more than pay for the increase in the monthly car payment. Second, and more important, most of these technologies have other attributes that are desired by consumers, so much of the explosion in 7+ speed transmissions, GDI, turbocharging, and lightweighting is because consumers want the performance provided by these technologies.
I might touch on safety - haven't decided yet.

One thing that would help me is if you have a summary of the TAR, in particular comparing the technology projections in the TAR to those in the 2017-25 rule. I just have not had time to read the TAR myself, as we are struggling to get our technology papers out in time to meet the Sept. 26 deadline for comments on the TAR, Ex. 6 - Personal Privacy
Ex. 6 - Personal Privacy

John

On Sep 14, 2016, at 2:28 PM, Moran, Robin <moran.robin@epa.gov> wrote:

Hi John,

I hear you have the honor of being a testifier at the Congressional hearing on the midterm review next week. Could you let me know what your key messages will be, or even maybe share a draft testimony? I'm helping with all the prep for Janet's testimony.

Ex. 6 - Personal Privacy

Take care,
Robin

Robin Moran
Senior Policy Advisor
U.S. EPA, Office of Transportation and Air Quality

2000 Traverwood Dr.
Ann Arbor, MI 48105
(734) 214-4781 (phone)
(734) 214-4821 (fax)

From: Moran, Robin
Location: AA-Room-Office-S109-ConfRoom/AA-OTAQ-OFFICE
Importance: Normal
Subject: NGOs meeting on MTE
Start Date/Time: Wed 6/10/2015 5:00:00 PM
End Date/Time: Wed 6/10/2015 6:00:00 PM
Searching for Hidden Costs AERE 20150528.pptx

The Agenda for the 6/10 will focus on consumer acceptance:

- Gloria presents the AERE presentation on content analysis (~20 minutes) -- attached
- Questions/discussion with NGOs

Ex. 5 - Deliberative Process

UCS set up this "standing" meeting for the next 6 weeks to get through a list of technical topics (below). I'll coordinate with Jonna before each call to get more clarity on what they want to discuss. For example, we covered a lot of cost/effectiveness on the last call, so I'll find out what more they want to discuss for the first call on 6/10.

From Jonna Hamilton, UCS:

We will use this time to do a series of technical conversations around LDV. I am setting this up as a standing meeting for 6 weeks starting on June 10.

Below is a proposed list and order of topics:

1. Cost and effectiveness
2. How far along are they in determining penetration and effectiveness of technologies and figuring how that changes going forward?
3. Should we be chiming in and/or echoing on technology effectiveness and cost?
4. A/B comparisons and what EPA/NHTSA and/or NRC got right/wrong
5. Lack of effect on MSRPs (not as good as teardowns, obviously, but only real "cost" publicly available)?
6. What assumptions are in the mid-term evaluation that are having adverse impacts on the effectiveness of the rule, and is EPA reconsidering?
7. Continued trade-offs between increased effectiveness and performance and manufacturers choosing performance
8. Turbo downsizing - not clear how effective it is in reality -how will it figure into the next round?
9. Car vs truck definition -- is this a loophole and/or something the agencies will be looking at?
10. What did the agencies get wrong?
11. Lightweighting and safety--is it really an issue? Could point to current lightweighting vehicles as well as studies.
12. Any other technologies they assumed would have high penetration rates that aren't, or vice versa, including A/C and CVT
13. Public acceptance
14. Consumer choice and consumer response to low gas prices
15. Marketing data
16. OEM focal points

17. Credit markets and compliance - overall and each OEM
18. ZEVs and federal policy

From: Moran, Robin
Location: AA-Room-Office-S109-ConfRoom/AA-OTAQ-OFFICE
Importance: Normal
Subject: NGOs Call on MTE
Start Date/Time: Thur 5/21/2015 3:00:00 PM
End Date/Time: Thur 5/21/2015 4:00:00 PM

Jonna Hamilton of UCS sent the following agenda:

We can use this call in number - Ex. 6 - Personal Privacy onference Code
Joining the call on our end are - Dave Cooke (UCS), Luke Tonachel (NRDC), Hilary Sinnamon (EDF), Chet France (EDF), Jonna Hamilton (UCS), Jesse Prentice-Dunn (Sierra Club)

When we talked internally about a proposed agenda, we had a lot of issues that we would like to raise. It would be great if we can treat this first call as an overview call with subsequent calls that are deeper dives on issues. Ideally on this call, we will hear an overview of what EPA is working on and talk about those analyses, as appropriate, and then we would love to hear from you the areas that you think would be useful for the NGOs to conduct independent analysis on. Going forward, do you think it would be good to set up a standing meeting to get into detail on more topics - maybe every three weeks or so?

Agenda

1. Gather
2. Introduction - what we hope to get out of this and future calls
3. Overview of EPA's planned, ongoing, and completed work (Some questions we would like addressed - new tear down analysis? What are they doing that is more recent than what NAS is doing? Are others doing this kind of work?)
4. Discussion of EPA's work
5. Discussion of EPA and NHTSA - how is their work overlapping, what projects are NHTSA doing right now? How are technical teams between EPA and NHTSA working together?
6. What can our community be doing to be helpful?

Topics to dive into on subsequent calls:

a. Technology effectiveness and cost
b. Turbo downsizing - not clear how effective it is in reality -how will it figure into the next round
c. Trade- offs between increased effectiveness and performance
d. How far along are they in determining penetration and effectiveness of technologies and figuring how that changes going forward?
e. Light weighting
f. Credit markets and compliance - overall and each OEM
g. Consumer choice and consumer response to low gas prices
h. Marketing data
i. Any technologies they assumed would have high penetration rates that aren't, or vice versa
j. Car vs truck definition

Cc: Anup Bandivadekar[anup@theicct.org]; Nic Lutsey[nic@theicct.org]; Joe Schultz[joe@theicct.org]; Aaron Isenstadt[aaron.isenstadt@theicct.org]
To: Charmley, William[charmley.william@epa.gov]; Olechiw, Michael[olechiw.michael@epa.gov]; Alson, Jeff[alson.jeff@epa.gov]; Alberto@ARB Ayala[Alberto.Ayala@arb.ca.gov]; Mike McCarthy[michael.mccarthy@arb.ca.gov]
From: John German
Sent: Mon 12/19/2016 8:37:34 PM
Subject: Re: Technology papers - Publication of Transmission Working Paper

FYI, we just published our detailed working paper on lightweighting, written in cooperation with suppliers:
http://www.theicct.org/lightweighting-technology-development-and-trends-us-passenger-vehicles

Except for the diesel working paper, which we hope to publish in February, this is the last of our working papers. You can find the home page for all of the pages at:
http://www.theicct.org/series/us-passenger-vehicle-technology-trends
Note that the page includes both the detailed working papers we wrote with suppliers and the shorter ICCT technology briefs, so most of the subjects are listed twice.

Specific web links for the other detailed technology working papers are as follows:
http://www.theicct.org/downsized-boosted-gasoline-engines
http://www.theicct.org/automotive-thermal-management-technology
http://www.theicct.org/PV-technology-transmissions-201608
http://www.theicct.org/naturally-aspirated-gas-engines-201606
http://www.theicct.org/hybrid-vehicles-trends-technology-development-and-cost-reduction

Please let me know if you have any questions or would like additional information.

John

On Aug 29, 2016, at 2:29 PM, John German <john@theicct.org> wrote:

FYI, we just published our second detailed technology working paper, this one on transmissions. Dana, BorgWarner, ITB, and FEV contributed to this paper:
http://www.theicct.org/PV-technology-transmissions-201608

Unfortunately, we have not yet finished ICCT's technology "brief" on transmissions, summarizing the results and adding a bit about implications on the mid-term review. I will let you know when this has been completed.

The papers on gasoline turbocharged engines and thermal management have finished supplier review and are now undergoing a final internal review by our communications team. The lightweighting paper was sent out for supplier review on Aug. 10, with their comments due by August 31. We are still hopeful that these can be finished by the end of September, with the paper on diesels following by the end of the year.

John

On Jun 21, 2016, at 10:51 AM, John German <john@theicct.org> wrote:

FYI, we just published two papers on naturally aspirated gasoline engines. These are the first in a series of technology reports in support of the 2017-25 mid-term review. Reports on transmissions, gasoline turbocharged engines, lightweighting, and thermal management will (hopefully) be finished by September, with a report on diesels following by the end of the year.

The first paper is the detailed working paper that we did in collaboration with Eaton, BorgWarner, and ITB.
Working paper: <http://theicct.org/naturally-aspirated-gas-engines-201606>

The second is ICCT's technology "brief", which summarizes the results of the working paper and adds a bit about implications on the mid-term review.
Tech brief: <http://theicct.org/naturally-aspirated-engines-techbrief-jun2016>

Let me know if you have any questions or want additional information.

John

To: French, Roberts[french.roberts@epa.gov]; Moran, Robin[moran.robin@epa.gov]; Alson, Jeff[alson.jeff@epa.gov]; Hula, Aaron[Hula.Aaron@epa.gov]
From: Dave Cooke
Sent: Wed 11/2/2016 9:42:31 PM
Subject: UCS Blog on 2016 EPA Trends and Compliance Reports

Thanks for the briefing on the two reports released today—it was very helpful. In case you didn't see it, here was the blog I put out today on the Trends and Compliance reports and their relationship to the MTE:

http://blog.ucsusa.org/dave-cooke/fuel-economy-reaches-highest-level-ever-as-automakers-continue-to-beat-epa-regulations

- Dave

To: danair@ucsusa.org[danair@ucsusa.org]
From: Don Anair
Sent: Tue 1/27/2015 6:59:14 PM
Subject: New UCS blog: Why low gas prices are no reason to roll back fuel economy and emission standards
removed.txt

Hi,

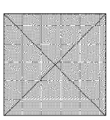
I wanted to share a recent blog post that might be of interest. I address some of the recent media coverage and automaker statements, particularly Chrysler, encouraging a change in fuel economy standards.

Thanks,

-Don

http://blog.ucsusa.org/dear-chrysler-5-reasons-oil-prices-shouldnt-affect-fuel-economy-standards-800

Dear Chrysler: 5 Reasons Oil Prices Shouldn't Affect Fuel Economy Standards



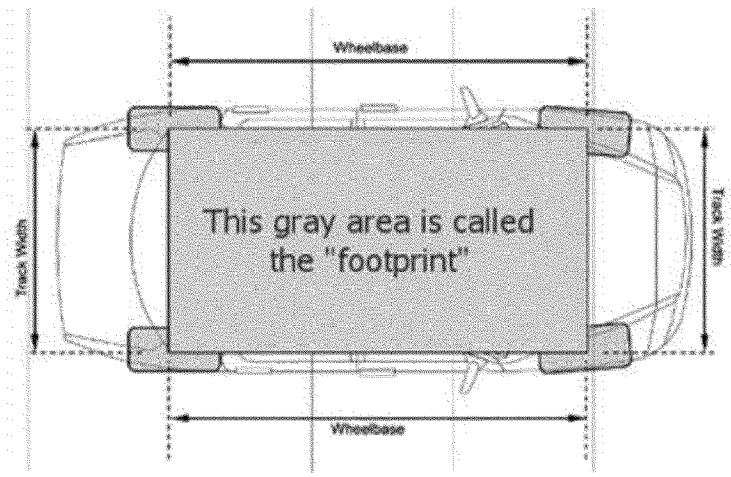
Don Anair, research and deputy director, Clean Vehicles

January 27, 2015

Lately, low gas prices have been making headlines across the country. Having dropped by more than $1.50/gallon over the last 6 months, there is certainly reason to be talking about them. So it was no surprise when the topic came up at the North American International Auto Show earlier this month in Detroit. The CEO of Chrysler, Sergio Marchionne, used the opportunity to call for rolling back vehicle fuel economy standards. This is perhaps not surprising from a CEO who also tells people not to buy his company's electric cars and who's company has scored last in 6 out of 7 UCS Automaker Rankings. But his statements on fuel economy appear to be as volatile as oil prices. Just a couple of years ago he stood up with the President and supported the new standards.

Low gas prices do not mean it's time to roll back clean vehicle standards – and here are 5 good reasons why:

1. We need cleaner cars AND trucks. Much has been made of recent vehicle sales showing a market shift toward larger vehicles, with last week's WSJ article "Clash Looms Over Fuel Economy Standard" highlighting the pushback expected from automakers on fuel economy standards. Regardless of what's causing the shift (and I dare say it is more than just low gas prices – since the increasing market share for trucks started in 2013 and was projected to grow in 2014 well before anyone knew gas prices were going to plummet), it's important to understand what impact that will have on automakers ability to comply with federal fuel economy and greenhouse standards.



A vehicle manufacturer's fuel economy requirements are based on the size of vehicles sold, as defined by the vehicle footprint (track width multiplied by the wheelbase). A larger wheel base means a lower fuel economy target.

In a word – none.

Increased market share of larger vehicles will lead to more oil consumption and emissions, but it's no reason to rollback standards. In fact, the standards were designed to accommodate shifts in the vehicle mix. Instead of setting a single fuel economy or greenhouse gas emission number and making every manufacturer meet it, the standards are set based on the size (or footprint) of the vehicles that are sold by each manufacturer.

The fuel economy and greenhouse gas standards are often described as requiring automakers to meet a 54.5 mpg standard in 2025. In reality, this figure is just an estimate based on an assumption about the size of vehicles that are expected to be sold in 2025 across the entire US market. If the size of vehicles sold in 2025 differs from the assumptions, then so will the average fuel economy target for each manufacturer.

Can automakers meet fuel economy standards if they sell more trucks? Absolutely. If Ford stopped selling cars, and only sold F150's with it's new 2.7 liter V6 EcoBoost engine, Ford would not only be compliance with today's standards, but would already be complying with standards as far out as 2021. (Photo: Courtesy of Ford Motor Company.)

Consider this. What if Ford only sold F150's equipped with their new 2.7-liter EcoBoost engine and no other vehicles?

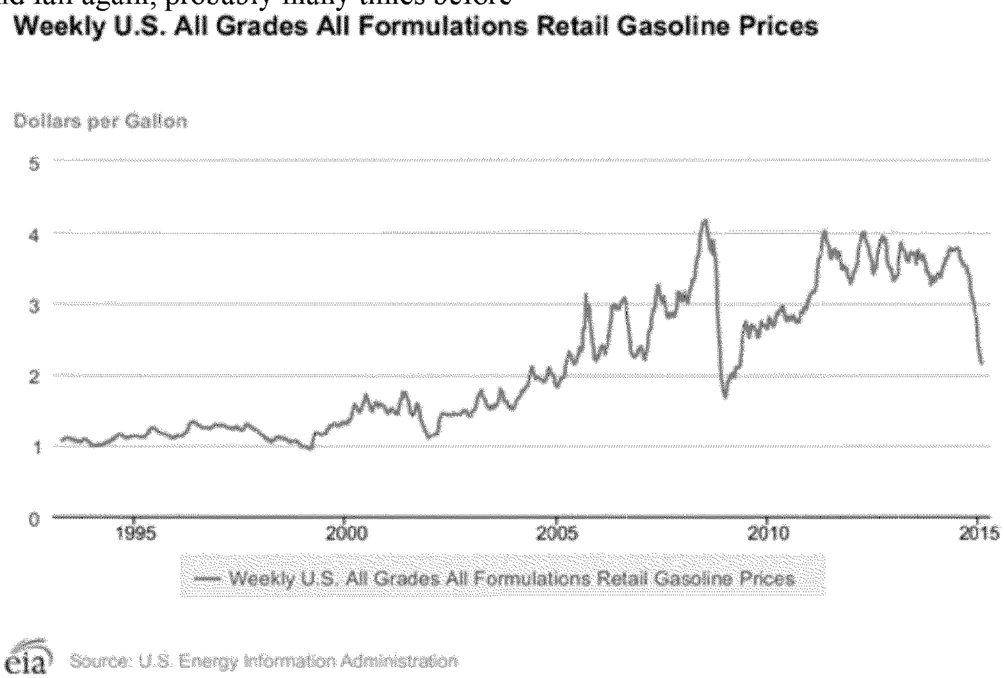
You might think they wouldn't have a chance at meeting the fuel economy standards. In fact, not only would they be in compliance with this year's fuel economy target, but Ford would be years ahead of the standard.

The two-wheel drive 2015 F150 2.7L is rated on government fuel economy tests at a combined highway/city fuel economy of 28.5 mpg (the actual consumer label value is 22 mpg – see more about the difference in this factsheet). The average footprint of the F150 is 65.67 sq ft assuming the shortest truck bed length option and the current market share of standard, crew and extended cab versions of the F150. The fuel economy target in 2015 for a truck with this size footprint is 24.83 mpg and doesn't reach 28 mpg until 2021. Even the four-wheel drive version of the F150 with slightly worse fuel economy already meets the standard set for 2019.

So a shifting market share to trucks is not an excuse for a change in the standards, but certainly highlights the importance of implementing other policies to reduce fuel use and greenhouse gas emissions from transportation. Complementary policies include putting a price on carbon, consumer rebates to reduce the cost of cleaner cars or fees on higher emission vehicles, and low carbon fuel standards, among others.

2. Learn from history or be doomed to repeat it. Remember the sky-rocketing gas prices and subsequent economic crash of 2008? Fuel economy standards stalled in the 90's and early 2000's in large part due to automaker's intransigence. As gas prices rose, U.S. automakers were particularly vulnerable given their inefficient product offerings and better positioning by their global rivals with more efficient vehicle choices. This ultimately led to bankruptcy for GM and Chrysler. Consumers were complicit as well, shifting their purchases to larger, inefficient SUVs and trucks when gas prices were low.

Making policy and purchasing decisions based on the assumption that current gas prices will stay low has been tried before with devastating effect. Calling for a change in in standards because of plunging oil prices is a classic example of short-term thinking that totally ignores that prices will rise and fall again, probably many times before



2025.

3. What goes down must go up. Gas prices are volatile and dependent on global supply and demand. The current oil market is being influenced by both (according to EIA analysis). Fuel economy standards are partly responsible as improving efficiency of U.S. vehicles has slowed demand for oil in the U.S. while a boom in U.S. oil production has led to increasing global supply.

However, oil companies are already responding to lower oil prices. Stories of oil field layoffs and reductions in oil company investments in oil exploration and development should be a warning sign. At oil prices below $50 a barrel, fracking for hard-to-get oil in the U.S. is likely an economically losing proposition. As investments wane in production, so will supply to the oil markets. There's plenty of debate about how and when oil prices might change, but if history is any lesson volatile oil prices are here to stay.

Fuel economy standards remain an effective insurance policy against volatile oil prices. By 2025 new car fuel consumption will be about half compared to model year 2010. No matter if fuel prices are $3.00 or $6.00, keeping the standards in place means a vehicle owner's fuel bill will be cut in half for the life of the vehicle, not just when oil prices happen to be low.

4. Fuel economy remains a top consideration for consumers. Fuel economy is by no means the only consideration when buying a vehicle. Passenger seating, cargo capacity, and others are key factors in car buying decisions. But most people want their vehicle to also use the least amount of fuel possible, as well as do everything else that's important to them. This is true despite low gas prices, as seen by the results of the recent J.D. Power's study which found fuel economy remains the most influential factor for new vehicle buyers for the fourth year in a row.

5. Electric cars are key to cutting oil use and climate emissions – now's no time to slow down. Low gas prices are not helpful to boosting electric vehicle sales, but it doesn't mean the sky is falling either. A quick look at the Department of Energy's eGallon calculator shows the average fuel costs for an EV are about half that of a comparable conventional gasoline vehicle. In many states, charging on off-peak hours (when your car is parked overnight) means even lower fuel costs. Last year plug-in EV sales, both plug-in hybrid and battery-electric, grew by 23 percent.

California's Zero Emission Vehicle (ZEV) program, also being implemented in 9 other states, is helping to propel the EV market forward and compelling automakers to invest in these technologies. This is important to make sure EVs, a key strategy to cutting our projected oil use in half by 2035 and slashing our carbon emissions 80% by 2050, become more cost competitive and a viable option for more consumers. Many of the states, including CA, that have adopted the ZEV program are also committing resources to making the roll out of these vehicles a success with state incentives, carpool lane access, infrastructure development, and other support. In other words, the automakers are not alone in this endeavor.

In terms of meeting the federal fuel economy and greenhouse gas standards for 2025, the vast majority of compliance will come from "plain vanilla technology" as Chrysler CEO Marchionne put it – meaning improvements in engines, transmission, and other conventional technologies. EPA's estimates for compliance with the standards show only about 5% hybrids and 2% plug-in vehicles needed in 2025 to achieve a fleet average the equivalent of 54.5 mpg. Every EV a manufacturer sells in a ZEV state will help them meet the federal fuel economy and greenhouse gas standards, but there's no requirement for automakers to be selling millions of EVs outside of ZEV states to comply with fuel economy standards now or in 2025. Of course that doesn't mean there isn't a market for them, like in Atlanta for example.

When supporting the standards in 2011:

Marchionne said the three Detroit automakers ended a "bad habit of crying wolf" and opposing higher standards. That's largely because the companies' current chief executives came from outside the industry.

...

"We looked at this and said this can be done, as business people who did not grow up and did not become conditioned by traditions of Detroit," Marchionne said.

Perhaps Mr. Marchionne has spent a little too much time in Detroit.

Don Anair

Research and Deputy Director, Clean Vehicles Program
Union of Concerned Scientists

Please Note Our New Address!

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danair@ucsusa.org

To: Simon, Karl[Simon.Karl@epa.gov]; Charmley, William[charmley.william@epa.gov]
Cc: Drew Kodjak[drew@theicct.org]; French, Roberts[french.roberts@epa.gov]; Snapp, Lisa[snapp.lisa@epa.gov]; Olechiw, Michael[olechiw.michael@epa.gov]; Moran, Robin[moran.robin@epa.gov]; John German[john@theicct.org]
From: Alson, Jeff
Sent: Thur 9/1/2016 5:56:39 PM
Subject: EPA/ICCT conference call on gap between 2-cycle test and real world US fuel economy

Karl and Bill--this morning, Rob and I had an hour phone call with John German, Peter Mock, and Uwe Tietge of ICCT regarding the U.S. sections of their draft paper on the fuel economy/CO2 "gap." I am cc'ing Drew Kodjak and John German of ICCT as well in an effort to keep everyone on the same page.

Since we did not have a copy of the full draft paper (we had most of the technical sections on the US program, but with no conclusions or summary text), the ICCT staff kicked off the meeting by summarizing their work. Our initial feedback was that we did not have any major concerns with the ICCT technical analysis of how the gap has changed over time (their analysis is very similar to that of David Greene in his 2015 paper), but were far more concerned about the general framing and tone of the conclusions of the paper (as we were with the Greene paper last year).

On the question of the existence of a gap, there is consensus that there is a gap between 2-cycle fuel economy/CO2 and real world performance. Of course, this is not news to anyone, EPA has admitted that there is such a gap since 1985 when we first adopted adjustments to 2-cycle values for fuel economy labels. There was also consensus that there is no meaningful current gap between 5-cycle fuel economy/CO2 data and real world performance, as is shown in a key chart in the ICCT paper.

On the question of whether the gaps have been increasing over time, there is a general consensus that the gaps between test values and MyMPG consumer data increased between approximately 2002 and 2012 as shown by ICCT charts. Of course, EPA and congressional recognition of these trends was primarily responsible for the major 5-cycle fuel economy methodology that we developed in 2005-2006 and began using for labels in 2008. Based on the ICCT data, it appears that we may have "overshot" in 2005-2006 and real world performance has been "catching up" with the gap ever since, and now the 5-cycle appears to be "right on." The more limited data since 2012 suggests that the gap may be in a period of relative stability. I pointed out that one clear and unambiguous reason for 3-4% of the 8-9% change in the gap in the last decade was the big increase in ethanol content in gasoline, and that has also now reached an equilibrium, at least for the time being. The draft ICCT paper did not mention the role of ethanol in the gap, and I expect the final paper to do so.

On the question of whether the gap is likely to increase in the future, we agreed that this is conjecture. There are some reasons to expect it to increase, such as the fact that our current 5-cycle coefficients reflect larger gaps for high-mpg vehicles and lower gaps for low-mpg vehicles, and fleetwide mpg is of course rising. And as fuel consumption decreases, accessory loadings are likely to account for an increasing percentage of consumption, which would also inherently increase the gap. On the other hand, it is also possible that powertrain designs may become more robust over time, which was one of the goals of the 5-cycle methodology. The data will speak for itself, and EPA has shown that it is committed to revising 5-cycle coefficients over time. We also demonstrated this by increasing our assumed rulemaking gap to 23% in the recent draft TAR in order to account for the increasing ethanol content.

We emphasized that the most important point for us was that the paper recognize that we clearly and unambiguously account for the 2-cycle gap in our rulemaking benefits projections. While our standards are based on 2-cycle compliance, we convert national-average 2-cycle fuel economy and CO2 standards levels in our benefits projections to 5-cycle levels, therefore directly reflecting the 2-cycle based gap. We have done this in every fuel economy-related rulemaking that we have ever done since 1985. It appeared that the ICCT staff did not know this. Further, we pointed out that, in Rob's June 2015 Guidance Document re-calculation of the coefficients for the derived 5-cycle equations, there is extremely high regression correlation between 2-cycle data and 5-cycle data for the same vehicles (R values of 0.99 for city values and 0.96 for highway values), which give us great confidence that we can accurately reflect the 2-cycle gap in our rulemaking benefits projections by converting to 5-cycle values. It did not appear that the ICCT staff had seen this Guidance Document analysis, and we are sending it to them today. Based on the above, I told ICCT that we strongly objected to the statement in the August 16 ICCT memo that an increasing gap "threatens to undermine the standards."

I suggested that discussions of gap issues in the U.S. should not be "lumped in" with discussions of other countries. EPA has a 30-year track record of identifying and correcting gaps, whereas it appears that most/all other countries have failed to do so. If anything, the U.S. program should be a model for others, not lumped in with others.

Staff agreed on a process for moving forward. ICCT will finalize its paper and send us a final copy for review. EPA will prioritize our review and send comments or set up another call to minimize any delays in publication.

Jeff

To: John German[john@theicct.org]; Drew Kodjak[drew@theicct.org]
Cc: Charmley, William[charmley.william@epa.gov]; Uwe Tietge[uwe.tietge@theicct.org]; Peter Mock[peter@theicct.org]; French, Roberts[french.roberts@epa.gov]
From: Alson, Jeff
Sent: Tue 8/30/2016 8:22:54 PM
Subject: RE: For Immediate Attention: ICCT Publication on Growing Gap between 2-cycle Test and Real World Fuel Economy in US

How about Thursday 9 am or 11 am EST? I am available, and I think Rob French is as well. Someone from Bill's group may join us as well.

Getting a copy of the draft report would be extremely helpful, I have not found anyone at EPA who has a copy.

From: John German [mailto:john@theicct.org]
Sent: Tuesday, August 30, 2016 4:19 PM
To: Drew Kodjak <drew@theicct.org>
Cc: Alson, Jeff <alson.jeff@epa.gov>; Charmley, William <charmley.william@epa.gov>; Uwe Tietge <uwe.tietge@theicct.org>; Peter Mock <peter@theicct.org>
Subject: Re: For Immediate Attention: ICCT Publication on Growing Gap between 2-cycle Test and Real World Fuel Economy in US

Jeff and I have already talked about scheduling.

Peter is not available on Friday and I don't think I can get the latest draft to EPA in time for them to review before tomorrow morning, so Thursday morning is the only day that will work this week.

We could also do this on Tues. or Wed. morning next week (Peter is available on Monday, but I don't think EPA will come in to work on Labor Day).

John

On Aug 30, 2016, at 4:04 PM, Drew Kodjak <drew@theicct.org> wrote:

Jeff,

Would you please send us your availability for the rest of the week.

Mornings are the key for us, since we would like to include Berlin staff.

I assume we will be able to have this discussion by Friday of this week as we are trying to get this paper wrapped up.

I've dropped the rest of the group since this is moving to scheduling.

Drew

Drew Kodjak, J.D. | Executive Director
Tel: +1 (202) 534-1608 | Email: drew@theicct.org | Web: www.theicct.org
1225 I Street, NW, Washington DC
www.transportpolicy.net

On Aug 30, 2016, at 10:57 AM, Charmley, William <charmley.william@epa.gov> wrote:

John,

Thank you for offering to help. For EPA, Jeff Alson will be the lead on working with you to arrange a conference call on this topic so that the EPA staff can provide our comments/views on this draft report.

I spoke with Jeff this morning and he is happy to do that. If you can work directly with Jeff to set up a call that would be great.

Best regards,

Bill

From: John German [mailto:john@theicct.org]
Sent: Monday, August 29, 2016 11:10 AM
To: Charmley, William <charmley.william@epa.gov>
Cc: French, Roberts <french.roberts@epa.gov>; Snapp, Lisa <snapp.lisa@epa.gov>; Uwe Tietge <uwe.tietge@theicct.org>; Peter Mock <peter@theicct.org>; Anup Bandivadekar <anup@theicct.org>; Nic Lutsey <nic@theicct.org>; Drew Kodjak <drew@theicct.org>
Subject: Re: For Immediate Attention: ICCT Publication on Growing Gap between 2-cycle Test and Real World Fuel Economy in US

Bill,

I haven't seen a response from EPA to Drew's email, so I thought I should follow up.

I contributed to the US section of ICCT's draft publication, so I can help coordinate a call or meeting with EPA on this.

Let me know what days would work for EPA.

John

On Aug 21, 2016, at 12:45 AM, Drew Kodjak <drew@theicct.org> wrote:

Hi Bill,

Thanks for your note. I completely understand that you and your team have been buried in work over the last 6 months or more, which is why I wanted to send this note.

At the same time, I need to be fair to my staff and our funders. We are trying to publish this report, and we have not been able to get attention from EPA for several months now.

Yes, we can set a call up for next week. Would you please identify the staff that you would like to be have involved, and give us a couple dates and times that would work for you and your staff?

I will note that our findings - and EPA findings described below from 2008 - 2015 both show that the gap between the two cycle and five cycle tests has remained virtually unchanged since 2008 (EPA) and 2001 (ICCT). It looks to be like our results are consistent?

For scheduling purposes, please note that Peter and Uwe are in Germany, and so morning hours from 8 am to 11 am would be more considerate of their time (although they typically work at various hours, and can usually make themselves available at later times if need be).

I'm in China at the moment, back in the States on Tuesday and in DC on Friday.

Looking forward to catching up.

Drew

PS - Nic and John copied to keep them in the loop.

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Tel: +1 (202) 534-1608 | Email: drew@theicct.org | Web: www.theicct.org
1225 I Street, NW, Washington DC
www.transportpolicy.net

On Aug 19, 2016, at 12:22 AM, Charmley, William <charmley.william@epa.gov> wrote:

Dear Drew, Peter, Anup and others,

Thank you for reaching out to us again.

I would like to suggest that we arrange a time ASAP to discuss this report. The EPA technical staff have a number of technical issues with this report and the conclusions.

I have no doubt that ICCT reached out to me and others this past spring, and I apologize if we provided no input at that time. Most of us have had to put our lives on hold for the last 6 months I order to deliver a whole range of actions for Administrator McCarthy this spring and summer, including an RFS annual rule proposal, an aircraft GHG endangerment finding, the light duty GHG Draft TAR, and earlier this week the heavy-duty GHG Phase 2 program. Unfortunately that means a few things slipped through the cracks, including our feedback on this ICCT report.

We have a significant respect in OTAQ for the technical expertise and independence of ICCT, but I think you all would benefit from our more thoughtful feedback on this report.

Let me know if we can set something up for next week.

Best regards,

Bill

Sent from my iPhone

On Aug 17, 2016, at 12:02 AM, Drew Kodjak <drew@theicct.org> wrote:

Bill, Rob, Lisa,

In early April, I presented information at the EPA's International Compliance Summit showing ICCT research demonstrating a growing gap between real world fuel economy and type approval values in Europe and in other countries including the US.

In Europe, our research has demonstrated a growing gap from 8% in 2002 to over 40% in 2015. As a result, half of the expected benefits from EU's CO2 standards for passenger cars have not been realized - a major cause of concern and much needed regulatory attention.

In the United States, we have examined real world emissions against the two cycle and the five cycle tests. The good news is that real world emissions are very close to the values produced by the 5 cycle test. The bad news is that real world emissions compared with the 2-cycle test have grown by 11 percentage points from 2001 to 2015. Specifically, we found a gap of 14% in 2001 and 25% in 2015. While this increase is far less than in Europe, it is still substantial enough to cause concern.

In April - Junc, Uwc Tictgc, our lcad rcscarchcr on this topic, rcachcd out to several of your staff as you suggested to seek review and engagement from EPA to ensure that our results are sound. These results also underwent extensive internal review at ICCT. At this point, we are comfortable with these results and the paper is on track for publication.

All that said, I wanted to make sure that you were aware of the latest developments well in advance of any ICCT publication. I asked Uwe to draft a short memo, which is attached, giving you the key graphics and messages.

Please let us know if you would like to follow up, recognizing that we have already reached out to you several times for review and comment, and we have a publication schedule that we would like to adhere to.

Finally, congratulations on a successful publication of the final HDV GHG regulation - a major accomplishment that will have ripple effects in major markets around the world.

<ICCT_memo_fuel_economy_gap_US.pdf>

Drew Kodjak

Executive Director

International Council on Clean Transportation

202-534-1608 (desk)

drew@theicct.org

On Apr 8, 2016, at 8:48 PM, Charmley, William <charmley.william@epa.gov> wrote:

Dear Drew,

It was good to see you yesterday.

One topic you raised to me yesterday was some new technical work that ICCT technical staff have undertaken to look at the relationship world wide between the regulatory test cycles for standard setting for GHG/CO2 and fuel economy and the comparison to the real world or fuel economy labeling test cycles. As you know, in the U.S. we us the 2-cycle FTP/highway fuel economy tests for GHG and CAFE standards, and we use the 5-cycle test cycles for criteria pollutants and for the fuel economy label.

I suspect that for the U.S., EPA has the most complete data set of 2-cycle/5-cycle test data from the same vehicle. When EPA finalized the 2008 Fuel Economy Labeling rule, we provided ourselves with the discretion via guidance to update in the formula which under certain conditions an auto company can utilize 2-cycle data for the fuel economy label (a 2-cycle to 5-cycle translation).

In June of 2015 the OTAQ Compliance Division (Byron's group) issued a Guidance letter, where, based on a detailed analysis by the Compliance Division staff, we updated this formula, as the most recent data indicated that the "gap" between 2-cycle and 5-cycle had grown a little since compared to what we estimated in the 2008 rulemaking. This change for the fuel economy label became mandatory for the 2017 model year. It directionally will bring the label values down for companies using the 2-cycle methodology. I have attached a copy of this Guidance Document, which includes the analysis by EPA justifying this new requirement. Rob French on Byron's staff lead this assessment.

We would be interested in learning about any new assessment that ICCT is doing in this area, so please keep us informed. In particular, if ICCT is going to issue a report on this topic we would appreciate any opportunity to review and comment on the draft report. If that is not possible, we would appreciate any opportunity to know what the report will say and when it may be released.

Best regards,

Bill

Bill Charmley

Director

Assessment and Standards Division

Office of Transportation and Air Quality

U.S. Environmental Protection Agency

National Vehicle and Fuel Emissions Laboratory

2000 Traverwood Drive

Ann Arbor, MI 48105

desk ph. 734-214-4466

cell ph.   734-545-0333

e-mail: charmley.william@epa.gov

<EPA Guidance Document, CD-15-15, June 22, 2015, Derived 5-cycle Coefficients.pdf>

To: John German[john@theicct.org]
From: Alson, Jeff
Sent: Tue 8/30/2016 4:50:21 PM
Subject: RE: For Immediate Attention: ICCT Publication on Growing Gap between 2-cycle Test and Real World Fuel Economy in US

John, thanks. My inclination is to have a phone call (or face-to-face if you are in town and prefer that) to get all of us on the same page. I did not know anything about this ICCT work until I was forwarded a copy of the August 17 email from Drew to Bill Charmley/Rob French/Lisa Snapp (I did not attend the International Compliance Summit in April and still haven't been able to find anyone in OTAQ who heard Drew's presentation there), and all I have ever seen about the ICCT work is the 2.5 page memo by Uwe Tietge on August 16 which Drew attached to his August 17 email. My concerns with that memo center largely on tone (the final "Takeaway" was "threatens to undermine the standards"). I have not seen the draft ICCT report and so far have not found anyone in OTAQ who has seen it. We would be in a much better position to react if we could see the report, so maybe you could think about that. As you know as well as anyone, these test-cycle related issues are full of nuances.

Rob French will probably join us, so I am checking on his schedule. For me, Thursday of this week or Wednesday or Thursday of next week would be gppd days to talk or meet.

Jeff

From: John German [mailto:john@theicct.org]
Sent: Tuesday, August 30, 2016 11:40 AM
To: Alson, Jeff <alson.jeff@epa.gov>
Subject: Fwd: For Immediate Attention: ICCT Publication on Growing Gap between 2-cycle Test and Real World Fuel Economy in US

Jeff,

Is there a good time to talk about this, or should we handle via email?

John

Begin forwarded message:

From: "Charmley, William" <charmley.william@epa.gov>

Subject: RE: For Immediate Attention: ICCT Publication on Growing Gap between 2-cycle Test and Real World Fuel Economy in US

Date: August 30, 2016 at 10:57:30 AM EDT

To: John German <john@theicct.org>, "Alson, Jeff" <alson.jeff@epa.gov>

Cc: "French, Roberts" <french.roberts@epa.gov>, "Snapp, Lisa" <snapp.lisa@epa.gov>, Uwe Tietge <uwe.tietge@theicct.org>, Peter Mock <peter@theicct.org>, Anup Bandivadekar <anup@theicct.org>, Nic Lutsey <nic@theicct.org>, Drew Kodjak <drew@theicct.org>, "Moran, Robin" <moran.robin@epa.gov>, "Olechiw, Michael" <olechiw.michael@epa.gov>

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Thank you for reaching out to us again.

I would like to suggest that we arrange a time ASAP to discuss this report. The EPA technical staff have a number of technical issues with this report and the conclusions.

I have no doubt that ICCT reached out to me and others this past spring, and I apologize if we provided no input at that time. Most of us have had to put our lives on hold for the last 6 months I order to deliver a whole range of actions for Administrator McCarthy this spring and summer, including an RFS annual rule proposal, an aircraft GHG endangerment finding, the light duty GHG Draft TAR, and earlier this week the heavy-duty GHG Phase 2 program. Unfortunately that means a few things slipped through the cracks, including our feedback on this ICCT report.

We have a significant respect in OTAQ for the technical expertise and independence of ICCT, but I think you all would benefit from our more thoughtful feedback on this report.

Let me know if we can set something up for next week.

Best regards,

Bill

Sent from my iPhone

On Aug 17, 2016, at 12:02 AM, Drew Kodjak <drew@theicct.org> wrote:

Bill, Rob, Lisa,

In early April, I presented information at the EPA's International Compliance Summit showing ICCT research demonstrating a growing gap between real world fuel economy and type approval values in Europe and in other countries including the US.

In Europe, our research has demonstrated a growing gap from 8% in 2002 to over 40% in 2015. As a result, half of the expected benefits from EU's CO2 standards for passenger cars have not been realized - a major cause of concern and much needed regulatory attention.

In the United States, we have examined real world emissions against the two cycle and the five cycle tests. The good news is that real world emissions are very close to the values produced by the 5 cycle test. The bad news is that real world emissions compared with the 2-cycle test have grown by 11 percentage points from 2001 to 2015. Specifically, we found a gap of 14% in 2001 and 25% in 2015. While this increase is far less than in Europe, it is still substantial enough to cause concern.

In April - June, Uwe Tietge, our lead researcher on this topic, reached out to several of your staff as you suggested to seek review and engagement from EPA to ensure that our results are sound. These results also underwent extensive internal review at ICCT. At this point, we are comfortable with these results and the paper is on track for publication.

All that said, I wanted to make sure that you were aware of the latest developments well in advance of any ICCT publication. I asked Uwe to draft a short memo, which is attached, giving you the key graphics and messages.

Please let us know if you would like to follow up, recognizing that we have already reached out to you several times for review and comment, and we have a publication schedule that we would like to adhere to.

Finally, congratulations on a successful publication of the final HDV GHG regulation - a major accomplishment that will have ripple effects in major markets around the world.

<ICCT_memo_fuel_economy_gap_US.pdf>

Drew Kodjak

Executive Director

International Council on Clean Transportation

202-534-1608 (desk)

drew@theicct.org

On Apr 8, 2016, at 8:48 PM, Charmley, William <charmley.william@epa.gov> wrote:

Dear Drew,

It was good to see you yesterday.

One topic you raised to me yesterday was some new technical work that ICCT technical staff have undertaken to look at the relationship world wide between the regulatory test cycles for standard setting for GHG/CO2 and fuel economy and the comparison to the real world or fuel economy labeling test cycles. As you know, in the U.S. we us the 2-cycle FTP/highway fuel economy tests for GHG and CAFE standards, and we use the 5-cycle test cycles for criteria pollutants and for the fuel economy label.

I suspect that for the U.S., EPA has the most complete data set of 2-cycle/5-cycle test data from the same vehicle. When EPA finalized the 2008 Fuel Economy Labeling rule, we provided ourselves with the discretion via guidance to update in the formula which under certain conditions an auto company can utilize 2-cycle data for the fuel economy label (a 2-cycle to 5-cycle translation).

In June of 2015 the OTAQ Compliance Division (Byron's group) issued a Guidance letter, where, based on a detailed analysis by the Compliance Division staff, we updated this formula, as the most recent data indicated that the "gap" between 2-cycle and 5-cycle had grown a little since compared to what we estimated in the 2008 rulemaking. This change for the fuel economy label became mandatory for the 2017 model year. It directionally will bring the label values down for companies using the 2-cycle methodology. I have attached a copy of this Guidance Document, which includes the analysis by EPA justifying this new requirement. Rob French on Byron's staff lead this assessment.

We would be interested in learning about any new assessment that ICCT is doing in this area, so please keep us informed. In particular, if ICCT is going to issue a report on this topic we would appreciate any opportunity to review and comment on the draft report. If that is not possible, we would appreciate any opportunity to know what the report will say and when it may be released.

Best regards,

Bill

Bill Charmley

Director

Assessment and Standards Division

Office of Transportation and Air Quality

U.S. Environmental Protection Agency

National Vehicle and Fuel Emissions Laboratory

2000 Traverwood Drive

Ann Arbor, MI 48105

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cell ph. 734-545-0333

e-mail: charmley.william@epa.gov

<EPA Guidance Document, CD-15-15, June 22, 2015, Derived 5-cycle Coefficients.pdf>

To: Dave Cooke[DCooke@ucsusa.org]
Cc: Moran, Robin[moran.robin@epa.gov]
From: Alson, Jeff
Sent: Wed 6/22/2016 8:24:27 PM
Subject: RE: UCS Fact Sheet Series on the Midterm Review/2017-2025 regs

Dave, thanks for doing these fact sheets and sending to us. Have you aggregated the cumulative GHG reductions projections over time (say, out to CY 2050) to see if the "updated vehicle mix" reductions are more or less than the "original vehicle mix" reductions? It looks like the updated mix reductions are higher in the early years but lower in the later years, so don't know how it would net out overall. We are having a hard time getting a pure apples-to-apples comparison because we have changed some of our methodological tools. Based on the latest TAR run vs our original FRM run, we will probably say the GHG reductions are a little less, but it would be good to know what you would say if asked.

Jeff

From: Dave Cooke [mailto:DCooke@ucsusa.org]
Sent: Wednesday, June 22, 2016 12:18 PM
To: Charmley, William <charmley.william@epa.gov>; Alson, Jeff <alson.jeff@epa.gov>; Moran, Robin <moran.robin@epa.gov>; Olechiw, Michael <olechiw.michael@epa.gov>
Subject: UCS Fact Sheet Series on the Midterm Review/2017-2025 regs

EPA team,

I am sure you all are quite busy right now with your own MTE work, but I wanted to share some public-facing work that we at UCS have put together. Today we are kicking off a series of fact sheets discussing the 2017-2025 regulations and the mid-term review: http://ucsusa.org/midtermreview

The first in the series are 1) a summary of the 2017-2025 standards and their benefits; 2) an explanation of why these rules are important as the market shifts to more SUVs and how they continue to bring benefits, regardless of consumer behavior; and 3) the technology that manufacturers have developed, spurred by these rules, and why it means they can go farther.

We will continue to update the series with other relevant topics (consumer benefits despite low gas prices, the role of advanced technologies, etc.) throughout the next couple months, announcing new fact sheets via blog. The first blog kicking off the series is available here: http://blog.ucsusa.org/dave-cooke/epa-nhtsa-vehicle-efficiency-standards-midterm-review.

If you have any questions/comments/concerns, I'd be happy to respond. Thanks,

- Dave

David W. Cooke, Ph.D.

Senior Vehicles Analyst

Union of Concerned Scientists

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Washington, DC 20006

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e: dcooke@ucsusa.org

To: John German[john@theicct.org]
From: Alson, Jeff
Sent: Wed 6/22/2016 4:12:00 PM
Subject: RE: Technology Briefing papers - Publication of Naturally Aspirated Working Paper

John, thanks for sending this around and I think this series of papers will be a big help for those of us who want more "communications friendly" citations than our rulemaking documents. One minor correction—you should check the NHTSA cites when you spell their organizational name out, the brief has the wrong name in the first paragraph ("Transportation and" instead of the correct "Traffic"), and I think I saw a different wrong name in one other place too. I actually enjoy it when people get their name wrong—they deserve it!—but you will want to get the name right. Thanks again.

From: John German [mailto:john@theicct.org]
Sent: Tuesday, June 21, 2016 10:52 AM
To: Charmley, William <charmley.william@epa.gov>; Olechiw, Michael <olechiw.michael@epa.gov>; Alson, Jeff <alson.jeff@epa.gov>; Alberto@ARB Ayala <Alberto.Ayala@arb.ca.gov>; Mike McCarthy <michael.mccarthy@arb.ca.gov>
Cc: Anup Bandivadekar <anup@theicct.org>; NIc Lutsey <nic@theicct.org>; Joe Schultz <joe@theicct.org>; Aaron Isenstadt <aaron.isenstadt@theicct.org>
Subject: Re: Technology Briefing papers - Publication of Naturally Aspirated Working Paper

FYI, we just published two papers on naturally aspirated gasoline engines. These are the first in a series of technology reports in support of the 2017-25 mid-term review. Reports on transmissions, gasoline turbocharged engines, lightweighting, and thermal management will (hopefully) be finished by September, with a report on diesels following by the end of the year.

The first paper is the detailed working paper that we did in collaboration with Eaton, BorgWarner, and ITB.

Working paper: <http://theicct.org/naturally-aspirated-gas-engines-201606>

The second is ICCT's technology "brief", which summarizes the results of the working paper and adds a bit about implications on the mid-term review.
Tech brief: <http://theicct.org/naturally-aspirated-engines-techbrief-jun2016>

Let me know if you have any questions or want additional information.

John

To: Dave Cooke[DCooke@ucsusa.org]
From: Alson, Jeff
Sent: Fri 12/18/2015 1:49:21 PM
Subject: RE: Trends?

All good points. Makes me proud to be a UCS member!

One thing we are already thinking about is whether we can incorporate the fuel economy effects of A/C efficiency and off-cycle credits into our Trends fuel economy values (we did not try this year, I estimate that these impacts could have increased adjusted FE by about 0.2 mpg, and this will surely grow in 2015). If you have an opinion on that, let me know.

Regarding policy, I personally think that, in the long run, we have to move away from a principle of "curve neutrality" to "trying to tilt the market from trucks-to-cars and from higher-to-lower footprint." I take every opportunity to make this point internally. I suspect it will be extremely difficult to convince management to consider this in the MTE (they will want to open as few issues as possible to maximize the chance of keeping the status quo), but effective jawboning on this during the MTE can lay the groundwork for a more effective regulatory structure in 2026+. I intend to do some thinking about this topic next year, and again any input would be helpful.

If we don't talk again, have a great holiday season.

From: Dave Cooke [mailto:DCooke@ucsusa.org]
Sent: Thursday, December 17, 2015 6:07 PM
To: Alson, Jeff <alson.jeff@epa.gov>
Subject: RE: Trends?

Yeah, the contrast between Dan's and ours/NRDC's/ICCT's releases on the reports is pretty stark. Calling sales mix a loophole just doesn't make sense, although I think there are issues around some of the credits that I'm sure the rest of the NGO community will start to raise more in the MTE process, particularly given that OEMs are looking to expand the credit program.

I think the mix shift trend v. fuel economy trend is going to be close for MY2015, but I'm still hopeful that it should at least to one digit still be no worse than flat, since MY2014 was somewhat artificially low and MY2013 a little high already from the Hyundai/Kia weirdness. If it does go backwards, it'll make telling the story of the regulatory success harder, but it will go back up over time regardless because of the program's design so I think it's unfair to look at this as anything but temporary.

It would be helpful to get a heads-up on that major finding in advance, but I think for us we'll continue to focus on a bigger picture view instead of just that one number. It's a good reality check for thinking about overall climate impact, but I definitely prefer to view the success of a policy in a counterfactual way. But I'm sure we'll be thinking about whether there are opportunities through the MTE process to address market shifts and its effect on the efficacy of the current footprint curves as a driver for total reductions.

- Dave

From: Alson, Jeff [mailto:alson.jeff@epa.gov]
Sent: Thursday, December 17, 2015 2:23 PM
To: Dave Cooke
Subject: RE: Trends?

Yes, for the most part we were pretty happy with the press coverage. I think our management thinks that the decision to release the two reports jointly was a good one, so I think that will be the default from now on.

Dan was Dan, and his use of the "loophole" argument is most frustrating to us. He called me late yesterday and I told him that that was our biggest problem with his statement and quotes, since the "loopholes" were all known from the beginning and reflected in our technology feasibility demonstration. Without the "loopholes" we would never have gotten 54.5. He know this, but refuses to admit it publicly.

I am worried even more about the 2015 data, that mpg might be a decrease from 2014. While I will be stepping back and no longer leading the Trends team next year (it is time for Aaron to be seen as leading the effort, I am going to focus on policy development for the transition team), I will make sure that we give you guys more notice next year, especially if 2015 is lower than 2014.

Jeff

From: Dave Cooke [mailto:DCooke@ucsusa.org]

Sent: Thursday, December 17, 2015 5:08 PM
To: Alson, Jeff <alson.jeff@epa.gov>
Subject: RE: Trends?

Thanks, Jeff. I appreciate the feedback and the extra time you took with us to make sure we had the data right. While Dave Shepardson's piece released in advance of the report seemed aimed at convoluting a 54.5 mpg end target and the fleet mix shift, generally it does look to me based on the press pick-up so far that releasing both reports at the same time helped tell a balanced story consistent with what the rules are designed to do.

- Dave

From: Alson, Jeff [mailto:alson.jeff@epa.gov]
Sent: Wednesday, December 16, 2015 10:57 AM
To: Dave Cooke
Cc: Seth Michaels
Subject: RE: Trends?

Dave, that is a great blog, and everyone up to Chris Grundler has seen it and is thrilled.

From: Dave Cooke [mailto:DCooke@ucsusa.org]
Sent: Wednesday, December 16, 2015 12:09 PM
To: Alson, Jeff <alson.jeff@epa.gov>
Cc: Seth Michaels <SMichaels@ucsusa.org>
Subject: Trends?

Jeff,

Is the Trends report still being released today? I'm about to hop on a flight, so can you CC Seth Michaels (ccd here) the update? Thanks. We don't want to scoop you.

Seth, please coordinate the blog release with Chris.

- Dave

To: John German[john@theicct.org]
From: Alson, Jeff
Sent: Tue 3/10/2015 7:55:07 PM
Subject: FW: A short must-read auto blog celebrating EPA's role in promoting auto innovation

John, I just checked and the blog is still there, but they publish 10 or more every day so the site is hard to navigate. See the link at the bottom of this email chain.

From: Alson, Jeff
Sent: Thursday, March 05, 2015 12:58 PM
To: Grundler, Christopher; Simon, Karl; Charmley, William; Bunker, Amy; Haugen, David; Hengst, Benjamin; Birgfeld, Erin; Mylan, Christopher
Subject: A short must-read auto blog celebrating EPA's role in promoting auto innovation

This 5-minute read will put a smile on your face. We have been making this argument for years, but to have a normally-anti-EPA auto blog make this argument is unprecedented. I suggest that Chris consider sending this on to Janet and the Administrator and we should use it in various communications efforts, possibly in any response we make to the upcoming NAS report.

Jeff

From: Bolon, Kevin
Sent: Thursday, March 05, 2015 11:45 AM
To: Helfand, Gloria; Brown, Jarrod; Alson, Jeff; Sherwood, Todd; Moran, Robin; Hula, Aaron; Nam, Ed; Olechiw, Michael; Kargul, John; Moskalik, Andrew; Cherry, Jeff
Subject: RE: Tech Innovation - MTE: We've made the auto blogs

Best article ever. Thanks Jarrod.

- *Regular car buyers didn't know direct injection from a lethal injection, and most didn't care. If it was just about money, there wouldn't have been much incentive at all to really try and push the internal combustion engine to its limits of power, efficiency, and emissions — buyers just didn't know enough to care. But the experts at the EPA did. So the EPA applied that missing pressure*

- *Would anyone have bothered with pursuing this kind of tech if the EPA (and the EPA's analogues in other countries) hadn't made the rules that forced car makers' hands? I don't think so — at least not to the degree we're at today in such a relatively small timetable.*

- EPA is the unsung hero of modern speed.

-before the EPA came along, they never had any need *to be efficient,*

- And here's the other thing about the EPA — they believed in the American car industry during a time when no one else, even the industry themselves, did. They didn't tell the automakers how *to get the MPG and emissions results they wanted ...they just told them what they had to hit, and trusted they'd figure it out.*

And so on. And excellent summary of how regs have driven technological innovation.

-Kevin

From: Brown, Jarrod
Sent: Thursday, March 05, 2015 10:56 AM
To: Helfand, Gloria; Alson, Jeff; Sherwood, Todd; Bolon, Kevin; Moran, Robin; Hula, Aaron; Nam, Ed; Olechiw, Michael; Kargul, John; Moskalik, Andrew; Cherry, Jeff
Subject: Tech Innovation - MTE: We've made the auto blogs

Looks like we are not the only ones trying to defend ourselves when it comes to performance/efficiency…

http://jalopnik.com/the-unsung-reviled-hero-of-modern-high-performance-car-1689570711

- Jarrod

To: Moran, Robin[moran.robin@epa.gov]
Cc: Olechiw, Michael[olechiw.michael@epa.gov]
From: Alson, Jeff
Sent: Tue 2/24/2015 7:02:07 PM
Subject: RE: Oliver Schmidt of VW touting the virtues of US (vs. Europe) regulatory process

Okay, I read too much into your first note.

From: Moran, Robin
Sent: Tuesday, February 24, 2015 2:01 PM
To: Alson, Jeff
Cc: Olechiw, Michael
Subject: RE: Oliver Schmidt of VW touting the virtues of US (vs. Europe) regulatory process

Hmmm, good idea to keep Oliver's quotes handy, but I think he's talking about our regulatory process in general, not specifically supporting the level of the LD GHG standards per se (I wish!!)

From: Alson, Jeff
Sent: Tuesday, February 24, 2015 11:23 AM
To: Moran, Robin
Cc: Olechiw, Michael
Subject: RE: Oliver Schmidt of VW touting the virtues of US (vs. Europe) regulatory process

Robin, I haven't listened to it yet, but this sounds like it may a unique opportunity—an automaker who opposed the 2025 rule complementing our technical expertise—do you think we should ask someone to transcribe so we can choose some direct quotes for future use?

From: Moran, Robin
Sent: Tuesday, February 24, 2015 10:08 AM
To: Midterm Review
Subject: Oliver Schmidt of VW touting the virtues of US (vs. Europe) regulatory process

This is an uplifting clip (around 6 minutes in) of VW's Oliver Schmidt praising the superiority of US regulations because they're written by "technical experts (in Ann Arbor)" vs. Europe's process led by politicians. Also talks about the US regs' "solid foundation" and looking out into the future.

From: Carol Lee Rawn [mailto:rawn@ceres.org]
Sent: Monday, February 23, 2015 3:32 PM
To: Moran, Robin
Subject: Fwd: Virtues in US fuel economy standards

Hi Robin - this was forwarded to me - thought you might be interested in hearing about the superiority of the US regulatory processs!

Best, Carol Lee

Please listen to this clip starting at 5 minute mark.

http://www.autoline.tv/journal/?p=36071

That was Oliver Schmidt, the powertrain guy at VW NA (who is going back to Europe shortly).

Alan

--

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To: Moran, Robin[moran.robin@epa.gov]
Cc: Olechiw, Michael[olechiw.michael@epa.gov]
From: Alson, Jeff
Sent: Tue 2/24/2015 4:22:55 PM
Subject: RE: Oliver Schmidt of VW touting the virtues of US (vs. Europe) regulatory process

Robin, I haven't listened to it yet, but this sounds like it may a unique opportunity—an automaker who opposed the 2025 rule complementing our technical expertise—do you think we should ask someone to transcribe so we can choose some direct quotes for future use?

From: Moran, Robin
Sent: Tuesday, February 24, 2015 10:08 AM
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That was Oliver Schmidt, the powertrain guy at VW NA (who is going back to Europe shortly).

Alan

--

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From: Charmley, William
Location: N158
Importance: Normal
Subject: Discussion with John German, ICCT (Bill will call John)
Categories: MTE
Start Date/Time: Thur 9/24/2015 5:00:00 PM
End Date/Time: Thur 9/24/2015 6:00:00 PM

John -

This appointment is too follow up on the presentation that you delivered at the August Asilomar conference on mass reduction.

Let me know if this time doesn't work for you.

Thanks
Bill

To: Olechiw, Michael[olechiw.michael@epa.gov]; Bolon, Kevin[Bolon.Kevin@epa.gov]
From: Caffrey, Cheryl
Sent: Tue 12/20/2016 7:36:49 PM
Subject: FW: Technology papers - Lightweighting paper - comments to and from John German

FYI: My comments to John are below his response here.

From: John German [mailto:john@theicct.org]
Sent: Tuesday, December 20, 2016 2:01 PM
To: Caffrey, Cheryl <caffrey.cheryl@epa.gov>
Subject: Re: Technology papers - Lightweighting paper

Thanks for reading it, Cheryl. Not many people go through the whole thing.

All of the technology working papers were always targeted at advancements since the rulemaking. It was quite an undertaking to obtain agreement from all of the participating suppliers on the contents, which was quite time consuming. And the process did not allow for revisions after the TAR was issued.

ICCT is preparing comments in response to the Proposed Determination. In this, we are updating the technology assessments from the working papers to compare with the ones in the Proposed Determination. So, this will likely be more in line with what you are looking for (although it will only be ICCT's position, not a joint position with suppliers).

The California reference was from CARB's technology assessment in support of their 2017-25 GHG standards. CARB disagreed with NHTSA and EPA on lightweighting cost and estimated it would only be $2.30/lb/%. I can dig this out if you want.

As for the lightweighting costs in the TAR (and the Proposed Determination). I think the studies upon which the costs are based are fine, but I disagree with how the study results have been used. (Note that this is my personal opinion - ICCT's comments on the Proposed Determination will not say anything about this - so please treat the following as confidential.)

- How can reducing weight by 5% reduce costs by $200? The answer is that most of this

cost reduction isn't due to weight reduction, but rather better design. And better design can reduce costs by more than $200 if it is done without reducing weight. So, I think you have misstated the baseline for the costs of weight reduction.
- EPA's method implicitly assumes that the first 5% of weight reduction will be all better design - with no usage of higher cost materials - the next step would be all HSS, and the last step would be all aluminum. This isn't what history has shown - HSS, aluminum, and plastics have been increasing steadily in their use, and thus material costs should be averaged with better design, even for 5% weight reductions.

Thus, I think the cost estimate in our lightweighting technology working paper better reflects how lightweighting design and material development will actually take place in the fleet.

But, again, this is my opinion, not that of ICCT.

John

On Dec 20, 2016, at 1:14 PM, Caffrey, Cheryl <caffrey.cheryl@epa.gov> wrote:

Hi John!

Mike Olechiw forwarded me the paper on lightweighting (see below) that you sent to him yesterday. It is a very interesting read with all of the perspectives and information shared.

I did have a question on the reference lightweighting curve used in the paper. The paper used the FRM 2017-2025 linear 'curve' for mass reduction which was 4.36/lb*%MR. Could you let me know why you didn't use the cost curve information from the Draft TAR which is the latest cost curve utilized in the Midterm Review? It was quite different from the rulemaking FRM.

In consideration of the information in your paper, the paper said that the mass reduction costs would be for up to 15% lightweighting and would be 1/3 of the original rulemaking MR costs (4.36/lb*15%*2.2=1.44/kg, 1.44/3=0.48/kg) – and this would be for all vehicle types. The Draft TAR has different costs for passenger cars and light duty trucks. For Passenger Cars the Draft TAR included a baseline cost curve (where baseline is with 0% curb weight change between 2008 and 2015) in which it was a cost save (even GM noted cost savings in some vehicles over 10%). The Draft TAR also included description of the cost curve movement as the percent baseline increased (ie: if the 2015 model curb weight was less than the 2008 model curb weight). In this case if a passenger vehicle had 5% lighter curb weight in 2015 compared to 2008 then the cost curve would be adjusted upwards and the $/kg at 15% (for example) would be about $1.5/kg. For LDT: The 0% baseline cost curve MR cost was about $1.7 at 15% and would go up from there if any baseline %MR was present in the vehicle (ie: lighter in 2015 compared to 2008).

I am interested in your feedback on these Midterm Evaluation/Proposed Determination curves as well. I am also interested in your reference which says "California Air Resources Board (CARB) estimated lightweighting cost was only about half of this, $2.30/pound/% reduction" – what was this reference?

Thank you!

Cheryl Caffrey

Cost Curve for Pass Cars in Draft TAR:

(red curve) For vehicles with no decrease in curb weight between 2015 and 2008

(blue curve) For vehicles with 5% reduction in curb weight in 2015 compared to 2008 (about $1.6/kg)

<image001.jpg>

Cost curve for LDT in Draft TAR:

<image003.jpg>

From: Olechiw, Michael
Sent: Tuesday, December 20, 2016 6:50 AM
To: Caffrey, Cheryl <caffrey.cheryl@epa.gov>; Fernandez, Antonio <fernandez.antonio@epa.gov>; Safoutin, Mike <safoutin.mike@epa.gov>; McDonald, Joseph <McDonald.Joseph@epa.gov>; Bolon, Kevin <Bolon.Kevin@epa.gov>; Barba, Daniel <Barba.Daniel@epa.gov>; Kargul, John <kargul.john@epa.gov>; Moskalik, Andrew <Moskalik.Andrew@epa.gov>; Neam, Anthony <Neam.Anthony@epa.gov>; Cherry, Jeff <Cherry.Jeff@epa.gov>
Cc: Moran, Robin <moran.robin@epa.gov>
Subject: FW: Technology papers - Publication of Transmission Working Paper

ICCT Tech papers for your review.

Mike

From: John German [mailto:john@theicct.org]
Sent: Monday, December 19, 2016 3:38 PM
To: Charmley, William <charmley.william@epa.gov>; Olechiw, Michael <olechiw.michael@epa.gov>; Alson, Jeff <alson.jeff@epa.gov>; Alberto@ARB Ayala <Alberto.Ayala@arb.ca.gov>; Mike McCarthy <michael.mccarthy@arb.ca.gov>
Cc: Anup Bandivadekar <anup@theicct.org>; NIc Lutsey <nic@theicct.org>; Joe Schultz <joe@theicct.org>; Aaron Isenstadt <aaron.isenstadt@theicct.org>
Subject: Re: Technology papers - Publication of Transmission Working Paper

FYI, we just published our detailed working paper on lightweighting, written in cooperation with suppliers:

http://www.theicct.org/lightweighting-technology-development-and-trends-us-passenger-vehicles

Except for the diesel working paper, which we hope to publish in February, this is the last of our working papers. You can find the home page for all of the pages at:

http://www.theicct.org/series/us-passenger-vehicle-technology-trends

Note that the page includes both the detailed working papers we wrote with suppliers and the shorter ICCT technology briefs, so most of the subjects are listed twice.

Specific web links for the other detailed technology working papers are as follows:

http://www.theicct.org/downsized-boosted-gasoline-engines

http://www.theicct.org/automotive-thermal-management-technology

http://www.theicct.org/PV-technology-transmissions-201608 http://www.theicct.org/naturally-aspirated-gas-engines-201606

http://www.theicct.org/hybrid-vehicles-trends-technology-development-and-cost-reduction

Please let me know if you have any questions or would like additional information.

John

On Aug 29, 2016, at 2:29 PM, John German <john@theicct.org> wrote:

FYI, we just published our second detailed technology working paper, this one on transmissions. Dana, BorgWarner, ITB, and FEV contributed to this paper:

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On Jun 21, 2016, at 10:51 AM, John German <john@theicct.org> wrote:

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The first paper is the detailed working paper that we did in collaboration with Eaton, BorgWarner, and ITB.

Working paper: <http://theicct.org/naturally-aspirated-gas-engines-201606>

The second is ICCT's technology "brief", which summarizes the results of the working paper and adds a bit about implications on the mid-term review.
Tech brief: <http://theicct.org/naturally-aspirated-engines-techbrief-jun2016>

Let me know if you have any questions or want additional information.

John

To: Olechiw, Michael[olechiw.michael@epa.gov]; Safoutin, Mike[safoutin.mike@epa.gov]; Bolon, Kevin[Bolon.Kevin@epa.gov]; Lieske, Christopher[lieske.christopher@epa.gov]
From: Moran, Robin
Sent: Tue 12/20/2016 11:55:19 AM
Subject: RE: Technology papers - Publication of Transmission Working Paper

We should put all these papers in the docket (whichever ones new since TAR) … volunteer?

From: Olechiw, Michael
Sent: Tuesday, December 20, 2016 6:50 AM
To: Caffrey, Cheryl <caffrey.cheryl@epa.gov>; Fernandez, Antonio <fernandez.antonio@epa.gov>; Safoutin, Mike <safoutin.mike@epa.gov>; McDonald, Joseph <McDonald.Joseph@epa.gov>; Bolon, Kevin <Bolon.Kevin@epa.gov>; Barba, Daniel <Barba.Daniel@epa.gov>; Kargul, John <kargul.john@epa.gov>; Moskalik, Andrew <Moskalik.Andrew@epa.gov>; Neam, Anthony <Neam.Anthony@epa.gov>; Cherry, Jeff <Cherry.Jeff@epa.gov>
Cc: Moran, Robin <moran.robin@epa.gov>
Subject: FW: Technology papers - Publication of Transmission Working Paper

ICCT Tech papers for your review.

Mike

From: John German [mailto:john@theicct.org]
Sent: Monday, December 19, 2016 3:38 PM
To: Charmley, William <charmley.william@epa.gov>; Olechiw, Michael <olechiw.michael@epa.gov>; Alson, Jeff <alson.jeff@epa.gov>; Alberto@ARB Ayala <Alberto.Ayala@arb.ca.gov>; Mike McCarthy <michael.mccarthy@arb.ca.gov>
Cc: Anup Bandivadekar <anup@theicct.org>; NIc Lutsey <nic@theicct.org>; Joe Schultz <joe@theicct.org>; Aaron Isenstadt <aaron.isenstadt@theicct.org>
Subject: Re: Technology papers - Publication of Transmission Working Paper

FYI, we just published our detailed working paper on lightweighting, written in cooperation with suppliers:

http://www.theicct.org/lightweighting-technology-development-and-trends-us-passenger-vehicles

Except for the diesel working paper, which we hope to publish in February, this is the last of our working papers. You can find the home page for all of the pages at:

http://www.theicct.org/series/us-passenger-vehicle-technology-trends

Note that the page includes both the detailed working papers we wrote with suppliers and the shorter ICCT technology briefs, so most of the subjects are listed twice.

Specific web links for the other detailed technology working papers are as follows:

http://www.theicct.org/downsized-boosted-gasoline-engines

http://www.theicct.org/automotive-thermal-management-technology

http://www.theicct.org/PV-technology-transmissions-201608

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To: Caffrey, Cheryl[caffrey.cheryl@epa.gov]; Fernandez, Antonio[fernandez.antonio@epa.gov]; Safoutin, Mike[safoutin.mike@epa.gov]; McDonald, Joseph[McDonald.Joseph@epa.gov]; Bolon, Kevin[Bolon.Kevin@epa.gov]; Barba, Daniel[Barba.Daniel@epa.gov]; Kargul, John[kargul.john@epa.gov]; Moskalik, Andrew[Moskalik.Andrew@epa.gov]; Neam, Anthony[Neam.Anthony@epa.gov]; Cherry, Jeff[Cherry.Jeff@epa.gov]
Cc: Moran, Robin[moran.robin@epa.gov]
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Cc: Anup Bandivadekar <anup@theicct.org>; NIc Lutsey <nic@theicct.org>; Joe Schultz <joe@theicct.org>; Aaron Isenstadt <aaron.isenstadt@theicct.org>
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Let me know if you have any questions or want additional information.

John

To: Midterm Review[Midterm_Review@epa.gov]
From: Moran, Robin
Sent: Mon 10/17/2016 12:31:27 PM
Subject: ICCT blog post critique of the CAR jobs report

FYI, see link below.

From: John German [mailto:john@theicct.org]
Sent: Wednesday, October 12, 2016 7:59 PM
To: Charmley, William <charmley.william@epa.gov>; Olechiw, Michael <olechiw.michael@epa.gov>; Moran, Robin <moran.robin@epa.gov>; Bolon, Kevin <Bolon.Kevin@epa.gov>; Alson, Jeff <alson.jeff@epa.gov>; Mike McCarthy <michael.mccarthy@arb.ca.gov>
Subject: Fwd: The Latest News | Center for Automotive Research

I thought you might be interested in a blog that Aaron on our staff just posted in response to the CAR jobs analysis:

http://www.theicct.org/blogs/staff/latest-paper-by-CAR-is-not-what-it-thinks-it-is

John

To: Bolon, Kevin[Bolon.Kevin@epa.gov]
From: Dave Cooke
Sent: Thur 8/25/2016 7:08:28 PM
Subject: RE: Two quick questions re: EPA/NHTSA engine assessments

Yup, my remaining afternoon is entirely free today, as-is tomorrow (surprisingly). I can be reached at my office line when you have a chance: 202-331-6948.

Thanks,

- Dave

From: Bolon, Kevin [mailto:Bolon.Kevin@epa.gov]
Sent: Thursday, August 25, 2016 3:07 PM
To: Dave Cooke
Subject: RE: Two quick questions re: EPA/NHTSA engine assessments

Hi Dave,

I just returned to the office from vacation yesterday, so I'm sorry that you've had to wait for a response.

I think that I should be able to help answer your questions. Do you still have time this afternoon for a call? Any time before 5pm should be ok. If that doesn't work, I'm free tomorrow afternoon as well.

Best regards,

Kevin Bolon

Kevin Bolon, Ph.D.
Light Duty Center, Assessment and Standards Division
National Vehicle and Fuel Emissions Laboratory
U.S. EPA, Office of Transportation and Air Quality
734-214-4331 bolon.kevin@epa.gov

From: Olechiw, Michael
Sent: Wednesday, August 24, 2016 10:57 AM
To: Bolon, Kevin <Bolon.Kevin@epa.gov>
Subject: FW: Two quick questions re: EPA/NHTSA engine assessments

Kevin,

Please follow-up with Dave.

Mike

From: Dave Cooke [mailto:DCooke@ucsusa.org]
Sent: Friday, August 12, 2016 1:01 PM
To: Olechiw, Michael <olechiw.michael@epa.gov>
Subject: Two quick questions re: EPA/NHTSA engine assessments

Mike,

I continue to pour over the TAR and the volumes of research and analysis that the agencies have put together, and there were three pieces of information related to the engine that differed between the agencies that surprised me, and I wanted to see if I had that right and if there might be any further info that would bring them closer together.

1) **HCR:** In comparing the Volpe work to OMEGA, it appears that there is a huge discrepancy on HCR between the agencies (EPA is ~3% higher). I know that HCR was not included in the initial ANL work for Volpe, and purportedly NHTSA used EPA's engine maps for that tech, so this feels like something that will eventually move towards EPA's analysis.

2) **Cylinder Deactivation:** On the other hand, with cylinder deactivation, it seems like NHTSA is using much higher levels of improvement, especially for SUVs/trucks. Is there a clear reason for this discrepancy of which you are aware? I realize this might change as you look more at rolling deactivation or other technologies, but the differences (especially for SUVs) was pretty strong for these two, and it significantly affects how Volpe deals with HCR because of the (false) choice it places on HCR v. DEAC in the vehicle pathway.

3) **TDS:** In my examination of the two agencies' assessments, I was surprised to find that NHTSA's turbocharged, downsized engine effectiveness packages appear to be much more effective than EPA's, particularly since NHTSA relied on older engine maps. Is this a finding consistent with your analysis of the differences between the two agencies?

If there are not short answers to these questions, feel free to give me a call—I was mainly looking to truth-test some initial findings before I dig further at some of these issues. I thought maybe that since you all may have already worked out some of these differences in drafting the TAR you might have a quick synopsis explaining the larger discrepancies. While obviously the modeling tools used by the agencies for compliance are very different, which means that any fleet pathways for CAFE and GHG compliance in 2025 will have differences, in the FRM the inputs at least appear to be much more generally aligned than in the TAR, so I was trying to assess ways in which we might be able to provide clarity around these figures to help that process.

Thanks,

- Dave

David W. Cooke, Ph.D.

Senior Vehicles Analyst

Union of Concerned Scientists

1825 K Street, NW 8th floor

Washington, DC 20006

p: 202-331-6948

f: 202-223-6162

e: dcooke@ucsusa.org

Cc: Anup Bandivadekar[anup@theicct.org]
To: Caffrey, Cheryl[caffrey.cheryl@epa.gov]; Bolon, Kevin[Bolon.Kevin@epa.gov]
From: John German
Sent: Thur 5/7/2015 9:27:49 PM
Subject: Fwd: Lightweighting Examples...

Cheryl/Kevin,
In case you haven't seen this yet.

John

Begin forwarded message:

From: Anup Bandivadekar <anup@theicct.org>
Subject: Re: Lightweighting Examples...
Date: May 7, 2015 2:55:44 PM EDT
To: Zifei Yang <zifei.yang@theicct.org>
Cc: Nic Lutsey <nic@theicct.org>, John German <john@theicct.org>, Vicente Franco <vicente@theicct.org>, Peter Mock <peter@theicct.org>

Some videos from Munro about the BMW i3 teardown --
http://www.hybridcars.com/teardown-reveals-bmw-i3-is-most-advanced-vehicle-on-the-planet/

Impressive work.

On Apr 9, 2015, at 1:07 PM, Zifei Yang <zifei.yang@theicct.org> wrote:

Hi all,

Thanks again for keeping contributing to the lightweighting example collection. I'm a little behind in tracking the examples, but will catch up soon.

A cool presentation about Munro tear down BMW i3 into pieces is attached. Some features they highlighted:

The structural adhesives are really tough to join the body-in-white (carbon fiber) and chassis (aluminum)
Recycled carbon fiber used on roof panel
Individual battery modules that can be replaced seperately

Best,
Zifei

[The attachment munro-and-associates-BMW-i3-tear-down-Uncovering-the-secrets.pdf has been manually removed]

On Mar 4, 2015, at 9:43 PM, Nic Lutsey <nic@theicct.org> wrote:

Hi all,
Another lightweighting example: 2016 Chevrolet Malibu to get 300 lb (~9%) lighter:
http://www.autonews.com/article/20150304/OEM04/150309922?template=printart

Nic

<an_logo.gif>

[redacted]

[redacted]

On Feb 18, 2015, at 4:55 PM, Nic Lutsey <nic@theicct.org> wrote:

Hi all,
For the lightweighting file, two examples:

- Chevrolet Volt PHEV will get 243 lbs (~6%) lighter
- Mazda2 to get 7% lighter (stating high-strength steels), while also getting bigger

Nic

http://www.autonews.com/article/20150216/OEM06/150219927/fewer-pounds-and-better-chemistry-boost-16-volt-range

ELECTRO-LIGHT

Fewer pounds and better chemistry boost '16 Volt range

<article_tool_icon_letter.gif> Respond
<email.png>
<FacebookSquare30.jpg>
<LinkedinSquare30.jpg>
<TwitterSquare30.jpg>

General Motors engineers put the 2016 Chevrolet Volt on a diet to increase its performance and boost its range on a single battery charge to 50 miles from 38. The plug-in hybrid, which goes on sale in the second half of 2015, shed 243 pounds from the 2015 model. A significant share of that weight was cut from the gasoline-electric powertrain. Here’s how GM made the Volt’s powertrain lighter, along with some other notable engineering changes.

http://europe.autonews.com/article/20150217/ANE/150219876

[redacted]

Michael Specht

[redacted]

[redacted] You can download the new issue as well as past issues by clicking here.

[redacted]

http://europe.autonews.com/apps/pbcs.dll/article?AID=/20150217/ANE/150219876&template=printartANE

On Feb 13, 2015, at 2:39 PM, Nic Lutsey <nic@theicct.org> wrote:

Hi all,
Here's a report for the lightweighting files (though I couldn't download as ClimateWorks' sciencedirect subscription appears to have lapsed):
http://www.sciencedirect.com/science/article/pii/S0306261914002530

It appears to be based on this dissertation:
http://deepblue.lib.umich.edu/bitstream/handle/2027.42/102298/amle_1.pdf

Nic

<Lewis 2013 UMich lightweight EV.pdf>

On Feb 11, 2015, at 9:48 AM, John German <john@theicct.org> wrote:

Full speed ahead for aluminum

Prospects for the metal undimmed by F-150's modest mpg gain

http://www.autonews.com/article/20150202/OEM01/302029958/full-speed-ahead-for-aluminum

Some nice quotes here that I thought I would pass along, such as:

- "During a recent presentation to investors in Detroit, Ford product development chief, Raj Nair, said Ford is working on new grades of aluminum that will be more formable and that are expected to reduce weight by about 30 percent over high-strength steel."
- "Lightweighting improves capability," Nair said. "Reducing weight offers faster acceleration, better dynamics and shorter stopping distances," he told investors.
- Mike Murphy, vice president of global automotive for Alcoa, said, "They (Ford) said to us from the beginning it's not about CAFE. That's a tiny piece of the equation. It's about all of the performance attributes of the truck they are now promoting, added towing, improved handling, acceleration and braking. It's a total package,"

John

On Jan 28, 2015, at 1:38 PM, John German <john@theicct.org> wrote:

Really nice article, Nic. Even has some projections in it. Thanks for sending this along.
I am cc'ing Peter on this as well, as the article originated in London.

JOhn

On Jan 28, 2015, at 7:57 AM, Nic Lutsey <nic@theicct.org> wrote:

Hi all,
Here's a more general note on lightweighting. See the AutoNews story link (and below), suggesting ~4% aluminum increase use in cars per year in the US through 2025.

http://www.autonews.com/article/20150128/OEM10/150129811/auto-industry-drives-comeback-in-aluminum-prices

Also on the older question some of us have wondered about on US vs EU aluminum use, the article says 309 lb per vehicle in Europe. The TEDB data (see Table 4.15 at http://cta.ornl.gov/data/chapter4.shtml) source indicates 360 lb per US vehicle in 2012 (~9% of curb mass). So maybe the fleets are similar in percent curb mass that is aluminum.

Nic

[redacted]

[redacted]

[redacted]

On Dec 13, 2014, at 10:45 AM, Nic Lutsey <nic@theicct.org> wrote:

Hi all,
Another example for the lightweighting highlights library:
The 2015 Audi Q7 drops 716 lb (~14% from 5192 lb curb weight).

http://www.autonews.com/article/20141212/OEM04/141219941?template=printart
http://www.cdmunds.com/audi/q7/2014/fcaturcs-specs/

Nic

<an_logo.gif>

[redacted]

Richard Truett <rsslogo.jpg>

[redacted]

http://www.autonews.com/apps/pbcs.dll/article?AID=/20141212/OEM04/141219941&template=printart

On Nov 26, 2014, at 8:12 AM, Nic Lutsey <nic@theicct.org> wrote:

Hi Zifei et al,
For the folder on good news on the

lightweighting front, here's another story related to automakers' planned lightweighting efforts, this one related to Toyota adding aluminum body parts to luxury models (in addition to Prius):

http://asia.nikkei.com/Business/Companies/Toyota-embracing-aluminum-auto-bodies-to-boost-mileage

It talks about aluminum bodies (hoods, bumpers, doors and fenders) for 100 kg savings on luxury models for 0.5-0.7 km/L reduced fuel consumption. Also note that Toyota is rolling out of their Toyota New Global Architecture as well and has targeted mass reduction of "up to 20%" (attached).

Nic

<Toyota 20percent mass 2015 TNGA.pdf>

On Oct 23, 2014, at 10:59 AM, John German <john@theicct.org> wrote:

> Article suggests it is 900 pounds with the battery. In any case, if the 99 mile driving range is real world, then your guess of 250-300 pounds for the battery pack is probably OK. If thc 99 milc driving range is on the NEDC, then the battery pack might be somewhat lighter. Although with a 20 kW motor and a top speed of 75 mph, I doubt they will find many customers. Even the Smart Fortwo EV uses a 55 kW motor.tesla $35k
>
> There does seem to be a growing consensus that lightweighting can reduce the overall cost of BEVs. The outlier seems to be Tesla, which has said they plan to switch to less expensive materials (e.g. steel) for their $35k midsize car in a

few years to reduce cost.

John

On Oct 23, 2014, at 10:28 AM, Zifei Yang <zifei.yang@theicct.org> wrote:

> More lightweighting on electric vehicles.
>
> BMW and Daimler model Visio. M is **900 lbs** (without battery) with carbon fiber, aluminum for passenger compartment, and polycarbonate windows. With battery, probably 250-300 lbs more? (Smart Fortwo is around 1900 lbs)
>
> 20 hp electric motor, top speed 75 mph, driving range 99 miles.
>
> They claim to make it affordable, so the saving from smaller battery could balance out increased material cost?
>
> http://inhabitat.com/lightweight-visio-m-electric-car-weighs-in-at-only-900-pounds/visiom_tum_0001/
>
> Best,
> Zifci
>
> On Sep 9, 2014, at 9:54 AM, Zifei Yang <zifei.yang@theicct.org> wrote:
>
>> FYI.
>>
>> Top-selling two-seaters: 2016 Mazda MX-5 Miata/Roadster (Japan) shaved 220 lbs (9%) of

its new model compare to its
current 2005 model. Also shrink
the size--3 inches in overall
length and 1/2 inch in width.
http://www.detroitnews.com/article/20140904/AUTO0104/309040121

DuPont survey: Lightweighting
leads fuel efficiency
technologies to meet 2025
CAFE targets
http://www.compositesworld.com/news/lightweighting-goals-top-automotive-design-and-manufacturing-survey

Best,
Zifei

On Aug 14, 2014, at 10:43 AM,
Zifei Yang
<zifei.yang@theicct.org>
wrote:

> Jaguar Lightweight E-type.
> ONLY 6 in production.
> Aluminum bodyshell cut
> 250 lb (114kg) weight.
> Digital design of 230
> individual body
> components.
>
> http://www.greencarcongress.com/2014/08/20140812-jag.html
>
> Best,
> Zifei
>
> On Jul 16, 2014, at 4:12
> AM, Vicente Franco
> <vicente@theicct.org>
> wrote:

Just FYI

http://automotivemegatrends.com/articles/lightweighting-drives-materials-innovation-inside/

Vicente Franco
International Council on Clean Transportation
Neue Promenade 6 - Berlin 10178
+49.30.847.129.109 | vicente@theicct.org
ICCT - International Council on Clean Transportation Europe gemeinnuetzige GmbH
Managing Director: Dr. Peter Mock, Amtsgericht Charlottenburg HRB 143557, VAT-IdNr. DE284186076

On 16 Jun 2014, at 15:41, John German <john@theicct.org> wrote:

> A lot of interesting materials in the M3/M4. Unfortunately, these are BMW's high-performance versions of the 3-series and their sales are relatively low. It

looks like BMW considered a lot of the materials to be too expensive for the higher volume 3-seriese vehicles. On the other hand, this is how costs come down over time. OEMs test out new ideas on low volume vehicles, then later spread the ones that work to higher volume vehicles.

John

On Jun 15, 2014, at 10:09 AM, Nic Lutsey <nic@theicct.org> wrote:

> Hi all,
> Another lightweighting example: 180 lb (5% of curb weight) reduction from BMW 3-series M3/M4 for MY2015. This is notable in that the BMW 3-series (and M versions especially)

do a lot of other lightweighting already. A/the major reason they could accomplish this (I'm guessing…) is that they dropped the V8 and therefore could see direct plus indirect mass reduction benefits in engine supports, suspension, etc. The article mentions a handful of new carbon fiber parts (this might be made more cost-effective from the "scraps" from i3 carbon fiber processes?).
Nic

<BMW M3 M4 180 lb.pdf>

On Jun 11,

2014, at 1:09 PM, John German <john@theicct.org> wrote:

I don't suppose Ducker has done anything similar for Europe? Could be useful in our ongoing arguments over size versus weight standards in Europe.
John

On Jun 10, 2014, at 11:42 PM, Nic Lutsey <nic@theicct.org> wrote:

Hi all,

On the lightweighting front, see the latest on N American aluminum projections through 2025 from Ducker: http://www.greencarcongress.com/2014/06/20140610-ducker.html http://www.drivealuminum.org/research-resources/PDF/Research/2014/2014-ducker-report

Any by the way attached are the lightweighting slides that I presented in China last week. Mostly these are a synthesis of materials that a few of us have used before, but with a few tweaks, additions, and translation.

Nic

<Lutsey.day2_ENCN_v2.pptx>

On Jun 4, 2014, at 2:59 PM, Anup Bandivadekar <anup@theicct.org> wrote:

Ford introduces Lightweight Concept vehicle to showcase ongoing light-

weighting and advanced materials work; nearly 25% weight reduction

http://www.greencarcongress.com/2014/06/20140604-ford2.html
and
https://media.ford.com/content/fordmedia/fna/us/en/news/2014 builds-on-advanced-materials-use-with-lightweight-concept.html

On May 6, 2014, at 11:15 AM, Zifei Yang wrote:

Attached is slides from a webcast host by SAE today on "Lightweighting with Multi-Material Vehicles".

Ford talked about its lightweight strategy, challenges for multi materials, and a little bit about 2015 F-150 -- Strategy to meet CAFE standards: engine and chassis technologies are expensive, if apply weight reduction at high level, combine with secondary weight reduction, better fuel economy could be realized at lower cost -- Three steps for mass use of mass reduction technologies: Lightweight materials--> LW vehicle system--> carbon fiber -- When aluminum come into high volume production, recycling provide big cash advantages -- The

2015
F-
150
is
the
most
profitable
alternative
to
meet
CAFE
target
--
Q&A.
Will
the
customers
bear
all
the
raising
cost
of
F-
150,
what
the
price
will
be
like?
A:
It
will
be
priced
competitively.
Meanwhile,
the
customer
will
notice
the
improvement
made
by

the aluminum (improved performance and fuel economy…) -- Q&A. Since aluminum warm forming is not available for mass production, how to increase the strengthens of the material? A: It's simple. 6000 series aluminum, use a special heat treatment to increase the strength.

Nanosteel talked about

their business model, 3rd generation AHSS materials (1200 MPa, 20% elongation), EDAG study, and have a poll question for audience (not sure how many and who are the audience), though they are all important.

<PastedGraphic-9.pdf>
Dow talked about adhesive technology, and their technologies used

on Tesla Model S, GM Corvette Stingray, 2015 F-150, BMW i3 etc. and another pool question for audience (question is: what do you see as the main barrier for not using structure adhesive). The presenter said the results is similar to the feedback they collected

from
OEMs.
<PastedGraphic-
11.pdf>

Best,
Zifei

<SAE
lightweigh
May6
Webcastslides.pdf>
On
Mar
26,
2014,
at
5:08
PM,
John
German
<john@theicct.org>
wrote:

I
thought
BMW
was
going
to
produce
thc
carbon
fiber
panels
for
the
i3
and
i8
itself,
but
I
could
well

be
wrong.
John

On
Mar
26,
2014,
at
1:17
PM,
Anup
Bandivadekar
<anup@theicct.org>
wrote:

I
wonder
if
the
two
MY
2016
vehicles
using
carbon
fiber
body
panels
are
actually
BMW
i-
series
or
someone
else...

http://www.magna.com/media/press-
releases-
news/news-
page/2014/03/11/news-
release---
magna-
to-

produce-carbon-fiber-composite-body-panels

All,

Here's another example of lightweighting from the Geneva auto show

http://www.magnasteyr.com/capabilities/vehicle-engineering-contract-manufacturing/news-events/events/geneva-motor-show-2014

Best,

Vicente Franco
International Council on Clean Transportation
Neue Promenade 6 - Berlin 10178
+49.30.847.129.109 | vicente@theicct.org

From: John German John German
Reply: John German john@theicct.org
Date: 25 Feb 2014 at 21:59:41
To: Anup

Bandivadekar anup@theicct.org
Subject: Re: Lightweighting Examples...

Well, they are just using production waste to keep the costs down. Doesn't sound like it would be cost-effective on its own.
John

On Feb 25, 2014, at 3:56 PM, Anup Bandivadekar <anup@theicct.org> wrote:

Hi Zifei,
For now, I will keep this as an ongoing thread, and will request others to keep replying as

we discover more lightweighting applications:

Today, I learned that BMW is planning to use carbon fiber in wheels. This would be a first, if I'm not wrong: http://www.autoexpress.co.uk/bmw/85858/bmw-carbon-fibre-wheels-close-producion

Interesting that they talk about making not just steering wheels, but also the entire dashboard. I have no idea of the economics of all of this, but seems like BMW is leveraging it's i3 carbon fiber effort well.

Anup

On Feb 18, 2014, at 12:52 PM, Zifei Yang wrote:

Hi Anup,

These are all good sources. Thanks for sending to me and feel free to send more when you come across any. I will look into them.

Below is some more

info on Peugeot 308 SW:

CO_2 emission 85 g/km (Blue HDi version). 21% reduction. Good aerodynamic performance 0.73 m2

For an equivalent engine and equipment, the PEUGEOT 308 SW is the lightest vehicle in the segment. The new EMP2 platform makes possible a drastic weight reduction of 70 kg and the innovative technical design and the choice of innovative technical solution allow a further reduction of 70 kg. The weight of each part has been optimized while still maintaining the full capacity of the part (the bonnet and front wings are made of aluminum, some HSS, innovative materials, redefinition of parts). Around 9% mass reduction. http://www.peugeot.com/en/news/the-new-peugeot-308-sw-presented-for-the-1st-time-at-geneva-motor-show

Best,

Zifei

On Feb 18, 2014, at 2:36 PM, Anup Bandivadekar <anup@theicct.org> wrote:

hi Zifei, Sorry for the multiple emails, but here is an example of an investment announcement by company in lightweight manufacturing capacity. The amount here is small, but 150 jobs is very neat. Please be sure to capture both $$ as well as jobs added as you accumulate these examples.

http://shiloh.com/wp-content/uploads/2014/02/Shiloh_Indiana-Expansion_FINAL.pdf

Best,

Anup

On Feb 18, 2014, at 11:23 AM, Anup Bandivadekar wrote:

Also, some really good presentations here: http://www.cargroup.org/?module=Schedule&confID=5

JLR: Aluminum usage, see nice slides on manufacturing processes

http://vimeo.com/61276480
https://www.raeng.org.uk/events/pdf/InnovationAuto_Mark_V

On Feb 17, 2014, at 10:48 PM, Anup Bandivadekar wrote:

The new model from Peugeot is

supposed to have 140 kg weight reduction compared to the older version. Could you please try to find out more? Thanks,

Anup

Anup Bandivadekar

Passenger Vehicles Program Director International Council on Clean Transportation (ICCT)
1 Post Street Suite 2700San Francisco CA 94104
(415)-202-5754
anup@theicct.org

http://www.theicct.org/ Twitter: @TheICCT

Cc: Bolon, Kevin[Bolon.Kevin@epa.gov]; Olechiw, Michael[olechiw.michael@epa.gov]
To: Caffrey, Cheryl[caffrey.cheryl@epa.gov]
From: John German
Sent: Thur 4/23/2015 7:04:07 PM
Subject: Re: US/EU/China lightweight vehicle technology study - Next call April 28

At this stage, probably can't delay. Especially since Mike indicated he wasn't available the week of May 4 and I will be in China the week of May 11 (I scheduled for April 28 at Mike's request). I could revise the agenda, to try to get Ducker and A2mac1 to call in and give short presentations and take some Q&A.

John
On Apr 23, 2015, at 2:54 PM, "Caffrey, Cheryl" <caffrey.cheryl@epa.gov> wrote:

Hi John,

Thank you for all of your excitement in getting this project moving. However I do think we are moving a bit too quickly.

Currently we are in the process of examining the baseline methodology we have in mind for the MTE and are not yet sure how detailed vehicle data is going to be a part of the methodology. We need at least a week or maybe even two in order to evaluate our current methodology and determine how detailed data, such as that provided by A2Mac1, is going to fit into it.

Let me know if you can delay.
Thank you!
Cheryl Caffrey

From: John German [mailto:john@theicct.org]
Sent: Wednesday, April 22, 2015 3:25 PM
To: Olechiw, Michael; Bolon, Kevin; Caffrey, Cheryl; Doug Richman; Patrik Ragnarsson; Ed Opbroek; Russ Balzer; Jody R Shaw;george.coates@thephxway.com Coates; Ken White; Jan Guy; Amanda Kasik; Gina-Marie Oliver; Ingo.Sartorius@Plasticseurope.org; Patricia Vangheluwe; Pat Davis; Gong Huiming; Zhang Xiuli; ÕÔ¶¬êÆ; Ñî½à; ¹ùÇ§Àï; lvwang@catarc.ac.cn; Ian Hodgson; Drew Kodjak; Hui He; Zifei Yang; Anup Bandivadekar; Peter Mock; Keri Browning
Subject: Re: US/EU/China lightweight vehicle technology study - Next call April 28

Although I have not heard back from most people and I have had two people say they cannot make April 28, I have decided to schedule the next meeting for April 28 (8am PT/11am ET/5pm ECT) for two reasons. First, the proposed date is only 6 days away and we need to get moving. Second, both EPA and Ian Hodgson (EC) are available on April 28 and I would like to focus the next call on the data requirements, which will be largely determined by the regulators from EPA, EU, and China.

ICCT will once again set up a GoToMeeting for April 28. We will distribute this before the end of the week.

I talked to Scott Ulnick at Ducker this morning. He gave me some background information on the type of data that they can supply and how the data can be stratified:

- Region: North America, EU-27, other EU, Japan, China, S. Korea, South America, India.
- Vehicle Components, such as body-in-white, closures, bumpers, powertrain
- Materials: Type of materials (e.g. metals, plastics) and grades
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- Geographic: Their data is stored by the location of the final assembly plant. They also have sales, so they can link to where the vehicles are sold, but this would cost more.
- Vehicle models: Typically sort their data by vehicle class, such as A, B, C. They can dive deeper into models and manufacturers, but would cost more.

Please come to the April 28 call prepared to discuss the level of detail needed for the data collection. This is an important step before we can proceed with discussions with Ducker and A2mac1 on supplying data and cost.

Following is a tentative agenda for the April 28 meeting. Let me know if you have comments or suggestions on agenda items:

Tentative Agenda for April 28:

1) Discuss level of detail needed for the data collection, for the parameters laid out by Ducker.

   - Regions should be clear and I think we want the most detailed data possible on materials.
   - Do we want data by component or forming process, or is an overall vehicle assessment adequate?
   - Do we want data by vehicle model or manufacturer, or is market segment adequate?
   - Do we want data by both both location of final assembly plant and by market location?
   - EPA has requested an analysis of global platforms, so we need data on whether platform is local or global.

2) How does the data from A2mac1 overlap with that from Ducker? What unique data does each offer?

3) Who would like to be part of a group to discuss costs and contract proposals with Ducker and A2mac1?

4) How does data from the SAE-China Lightweight Alliance compare with these parameters? (Assuming SAE-China can make the call.)

John
734-355-1055

On Apr 20, 2015, at 5:59 PM, John German <john@theicct.org> wrote:

Existing studies: Two additional links:

- The European Aluminum Association has a public version of their latest Ducker report: http://www.alueurope.eu/wp-content/uploads/2012/04/EAA-Aluminium-Penetration-in-cars_Final-Report-Public-version.pdf
- A September 2014 report by the American Chemistry Council on "Plastics and Polymer Composites in Light Vehicles" is attached.

Next meeting. So far, I have only had feedback on the proposed April 28 meeting from EPA (yes), Ed Opbroek (yes), and Patrick Ragnarsson (no). Please let me know if April 28 works for you, so that we can get this scheduled or try to find a different time.

John

On Apr 17, 2015, at 2:42 PM, John German <john@theicct.org> wrote:

Thanks to everyone for participation in the kickoff meeting yesterday. We had a good discussion and helped lay out some parameters and next steps.

Notes from the meeting are attached. Note that I have reorganized this a bit, plus we have some additions and corrections from CATARC and SAE-China. Please let me know if you have any corrections or comments.

Next meeting. During the call, we tentatively discussed April 30. Unfortunately, EPA is not available on April 30 or the following week. They suggested that Tuesday, April 28 would be best for them. Please let me know your availability for April 28. Time would be the same - 8 PT/11ET/5 CET.

Existing studies:

- SAE Paper 2015-01-0574 on A2mac1 data and statistical methods by Malen & Hughes.

The authors are presenting this paper at next week¡¯s SAE Congress in Detroit ¨C Thursday morning, Paper is available on the SAE website. Abstract is b elow.

- Plastics report is at: http://www.plastics-car.com/Tomorrows-Automobiles/Plastics-and-Polymer-Composites-Technology-Roadmap/Plastics-and-Polymer-Composites-Technology-Roadmap-for-Automotive-Markets-Full-Report.pdf
- Please send me links to any additional materials.

Next Steps:

- WorldAutoSteel will organize a briefing on the statistical methods used for the A2mac1 SAE paper.
- ICCT will follow up with EPA (and EU and CATARC?) to define the level of segregation they need for the data.
- ICCT will follow up with organizations that are interested but have not yet committed to participating.
- By next meeting hope to be able to define a scope of work, so we can request proposals.
- Any other suggestions?

John

On Apr 13, 2015, at 4:09 PM, John German <john@theicct.org> wrote:

Following is the GoToMeeting information for our meeting this Thursday. Please let me know if you need additional information - or if you have suggestions for the agenda (attached again).

1. Please join my meeting, Apr 16, 2015 at 8:00 AM PDT. https://global.gotomeeting.com/join/616257053

2. Use your microphone and speakers (VoIP) - a headset is recommended. Or, call in using your telephone.

United States: +1 (224) 501-3316
Germany: +49 (0) 692 5736 7207

Access Code: 616-257-053
Audio PIN: Shown after joining the meeting

Meeting ID: 616-257-053
John
734-355-1055

Begin forwarded message:

From: John German <john@theicct.org>
Subject: Re: US/EU/China lightweight vehicle technology study - kickoff meeting April 16
Date: March 31, 2015 10:16:04 AM EDT

Sorry to take so long to pick a date for our kickoff meeting. This is a group of busy people and it was hard to come up with a day everyone could participate.

The best compromise is Thursday, April 16, 8am PT, 11am ET, 5pm CET (thanks to the steel folks for being flexible). I will sent up a GoToMeeting and send this with the call-in information in a followup email. We have a lot to cover so please plan on two hours for the meeting.

Attached is a draft agenda, along with a preliminary list of project goals. This includes ICCT's original ideas (below) and some input from EPA and WorldAutoSteel. I would appreciate any additional suggestions on the agenda and items that you would like to discuss - including the specific tasks that your organization would like to support.

While the meeting is focused on the participants, I am also sending this email to a number of potential participants and other interested observers. We encourage you to join the meeting and participate as appropriate.

John

<Plastics in LD vehicles - Sep2014.pdf>

To: John German[john@theicct.org]
Cc: Bolon, Kevin[Bolon.Kevin@epa.gov]; Olechiw, Michael[olechiw.michael@epa.gov]
From: Caffrey, Cheryl
Sent: Thur 4/23/2015 6:54:00 PM
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Sent: Wednesday, April 22, 2015 3:25 PM
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John

<Plastics in LD vehicles - Sep2014.pdf>

To: Bolon, Kevin[Bolon.Kevin@epa.gov]
From: International Council on Clean Transportation
Sent: Fri 1/30/2015 2:53:25 PM
Subject: Latest from the ICCT: Arctic shipping, Pacific Coast low-carbon fuels, the state of transport policy, airline fuel efficiency, and more

Cc: Bolon, Kevin[Bolon.Kevin@epa.gov]
To: Olechiw, Michael[olechiw.michael@epa.gov]
From: John German
Sent: Tue 1/27/2015 9:46:54 PM
Subject: Re: EPA participation in US/EU/China lightweighting study

Any update, Mike?
John

On Jan 14, 2015, at 4:25 AM, "Olechiw, Michael" <olechiw.michael@epa.gov> wrote:

John

I have not had the opportunity to speak with Bill yet. It was a short work week last week for me and I am now in Geneva at the GRPE. I have a meeting with Bill next week and I will discuss the issue with him then and get back to you. I know you are anxious to receive confirmation of our participation.

Best Regards,

Mike

Michael R. Olechiw
Director - Light-duty Vehicles and Small Engines Center
USEPA/OTAQ/ASD
2000 Traverwood Drive
Ann Arbor MI 48105
Tel: +1-734-214-4297
Mobile: +1-734-546-8079
Fax: +1-734-214-4050
olechiw.michael@epa.gov

From: John German [mailto:john@theicct.org]
Sent: Tuesday, January 13, 2015 9:53 AM
To: Olechiw, Michael; Bolon, Kevin
Subject: Fwd: EPA participation in US/EU/China lightweighting study

Mike,

As per the voice message I just left you, I am following up to see if you had a chance to run this by Charmley. We are anxious to get moving, but we don't want to misrepresent EPA's position either.

Also, following are the notes I circulated internally on Dec. 19. I thought I had sent this to you, but I can't find anything in my mail box so I am attaching it here. Let me know if you have any comments or corrections.

John

Begin forwarded message:

From: John German <john@theicct.org>
Subject: Re: EPA participation in US/EU/China lightweighting study
Date: December 19, 2014 6:25:18 PM EST
To: Anup Bandivadekar <anup@theicct.org>
Cc: Peter Mock <peter@theicct.org>, Fanta Kamakate <fanta@theicct.org>, Drew Kodjak <drew@theicct.org>, NIc Lutsey <nic@theicct.org>

I met with Mike Olechiw and Kevin Bolon at EPA this afternoon to discuss possible EPA contributions to our US/EU/China lightweighting study. They were very interested and engaged.

Bottom line - EPA's primary interest is in obtaining baseline lightweight material data. They need this for the mid-term review and they have been discussing ways to get this. They purchased a somewhat reduced access to the A2mac1 data, but this does not meet their needs. Thus, Mike is interested in participating in the ICCT study - and contributing maybe $50-$100k. Two caveats:

- Mike has to talk to Bill Charmley about this and get his blessing, so please keep this internal to ICCT until then.
- If ICCT is to do the work, contract mechanism is a problem. EPA would have to go through an existing contractor, such as FEV or ERG, who would take 20% off the top. Another option would be to carve out some work that one of EPA's existing contractors could do and EPA would pay them.

Let me know if you have any concerns about parting out some of the work to an EPA contractor. I told Mike that ICCT would prefer to do the work ourselves, but that the actual work process would be dictated by the organizations that put up the money.

Mike and Kevin also made some constructive suggestions for the project "methodology:

- 1) a) - Add "trim level" and feature content to the calculation of "mass-eficiency" - as this is probably more significant for vehicle weight than nameplate.
- 3) - Honda has raised the issue that worldwide platforms may sacrifice some lightweighting material benefit due to the need to use common materials worldwide (i.e. the latest materials may only be available from one supplier in one region). Kevin doesn't necessarily buy this, but they would like this included in the analyses.
- 4) - Need to consider the impact of government safety policies on lightweighting, not just efficiency/CO2 policies.

John

Cc: Bolon, Kevin[Bolon.Kevin@epa.gov]
To: Olechiw, Michael[olechiw.michael@epa.gov]
From: John German
Sent: Wed 1/14/2015 2:08:52 PM
Subject: Re: EPA participation in US/EU/China lightweighting study

Great! I'll hold off until next week.
John

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Mobile: +1-734-546-8079
Fax: +1-734-214-4050
olechiw.michael@epa.gov

From: John German [mailto:john@theicct.org]
Sent: Tuesday, January 13, 2015 9:53 AM
To: Olechiw, Michael; Bolon, Kevin
Subject: Fwd: EPA participation in US/EU/China lightweighting study

Mike,

As per the voice message I just left you, I am following up to see if you had a chance to run this by Charmley. We are anxious to get moving, but we don't want to misrepresent EPA's position either.

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John

Begin forwarded message:

From: John German <john@theicct.org>
Subject: Re: EPA participation in US/EU/China lightweighting study
Date: December 19, 2014 6:25:18 PM EST
To: Anup Bandivadekar <anup@theicct.org>
Cc: Peter Mock <peter@theicct.org>, Fanta Kamakate <fanta@theicct.org>, Drew Kodjak <drew@theicct.org>, NIc Lutsey <nic@theicct.org>

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Bottom line - EPA's primary interest is in obtaining baseline lightweight material data. They need this for the mid-term review and they have been discussing ways to get this. They purchased a somewhat reduced access to the A2mac1 data, but this does not meet their needs. Thus, Mike is interested in participating in the ICCT study - and contributing maybe $50-$100k. Two caveats:

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Let me know if you have any concerns about parting out some of the work to an EPA contractor. I told Mike that ICCT would prefer to do the work ourselves, but that the actual work process would be dictated by the organizations that put up the money.

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- 4) - Need to consider the impact of government safety policies on lightweighting, not just efficiency/CO2 policies.

John

To: John German[john@theicct.org]; Bolon, Kevin[Bolon.Kevin@epa.gov]
From: Olechiw, Michael
Sent: Wed 1/14/2015 9:25:40 AM
Subject: RE: EPA participation in US/EU/China lightweighting study

John

I have not had the opportunity to speak with Bill yet. It was a short work week last week for me and I am now in Geneva at the GRPE. I have a meeting with Bill next week and I will discuss the issue with him then and get back to you. I know you are anxious to receive confirmation of our participation.

Best Regards,

Mike

Michael R. Olechiw

Director - Light-duty Vehicles and Small Engines Center

USEPA/OTAQ/ASD

2000 Traverwood Drive

Ann Arbor MI 48105

Tel: +1-734-214-4297

Mobile: +1-734-546-8079

Fax: +1-734-214-4050

olechiw.michael@epa.gov

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John

To: Olechiw, Michael[olechiw.michael@epa.gov]; Bolon, Kevin[Bolon.Kevin@epa.gov]
From: John German
Sent: Tue 1/13/2015 2:53:10 PM
Subject: Fwd: EPA participation in US/EU/China lightweighting study

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John

Cc: Bolon, Kevin[Bolon.Kevin@epa.gov]; Olechiw, Michael[olechiw.michael@epa.gov]
To: John German[john@theicct.org]
From: Caffrey, Cheryl
Sent: Wed 7/22/2015 1:18:18 AM
Subject: Re: EPA Baseline

John,

Please see below.

Cheryl

From: John German <john@theicct.org>
Sent: Tuesday, July 21, 2015 4:09 PM
To: Caffrey, Cheryl
Cc: Bolon, Kevin; Olechiw, Michael
Subject: Re: EPA Baseline

Cheryl,
If I understand correctly, EPA's direction on lightweighting is to develop cost curves from the detailed lightweight studies done recently by FEV, Lotus, and EDAG, then use these to try to elicit OEM responses and data.

This sounds like a fine strategy to assess lightweighting potential, cost, and leadtime. But I am having trouble understanding what it has to do with the US/EU/China lightweighting comparison project we have been working on.

Michael Olechiw's email to me on January 29, 2015 stated:

> Having discussed the proposed program to evaluate the state of mass reduction on light-duty vehicles on a global scale with Bill Charmley, I am happy to report that we are interested in supporting this program. Our goals in supporting the work are as follows:
>
> 1. We expect the work to inform our mass reduction baseline analysis. The mass reduction baseline is meant to provide the agencies with an assessment of the mass reduction solutions that are already in production.
> 2. We hope to gain insight into impacts that global platform sharing has on the opportunity to reduce mass.

I don't see how developing cost curves from the four studies will help inform EPA's mass reduction baseline analysis.

1. The cost curves are the backbone of the cost/kg for a determined %MR.

Am I missing something here?

John

On Jul 2, 2015, at 11:23 AM, "Caffrey, Cheryl" <caffrey.cheryl@epa.gov> wrote:

Hi John,

Please see responses below.

Cheryl

From: John German [mailto:john@theicct.org]
Sent: Thursday, July 02, 2015 10:54 AM
To: Caffrey, Cheryl
Cc: Bolon, Kevin; Olechiw, Michael
Subject: Re: EPA Baseline

Thanks for the update and the additional information, Cheryl.

However, I'm not clear what this means for the US/EU/China lightweighting project. Are you saying that you need to wait until completion of the analyses and writeup for lightweighting? You have decided to focus on the four vehicles and will not participate? Something else?

- At this time it is my understanding that your question was whether the group needed to purchase the Ducker database and the A2Mac1 database to assist in the lightweighting vehicle characterization for the TAR. If I am not focused correctly then please provide additional information – it is very possible that I overlooked a focus of the group.

One question. You said, "The cost curves will likely be developed through detailed work with four specific vehicles". Given the wide difference from vehicle to vehicle in material use and lightweight design, how accurate it is to extrapolate from these four vehicles to the fleet?

- We have detailed cost curve information on four vehicles and I agree that the materials, designs and lightweight approaches amongst OEM's will differ and it will be impossible to characterize them all without their assistance in understanding their approaches. Our attempts at gathering specific information from the OEM's on their plans has shown to date to not be a fruitful exercise and hence I have taken the approach that we will go forward with a proposal and will wait for OEM comment on our analyses. The OEM's already know about the cost curves through the public Midsize CUV, Accord and light duty truck reports (through the SAE paper) and so can give us preliminary feedback on these curves (with data) if they desire at this time.

Related to this, you said, "The ability to understand the specific lightweight technologies on each vehicle would be a daunting task given the 1400 models and the information isn't readily available." This is accurate. However, A2Mac1 has detailed teardown data on about 150 NA vehicles. Wouldn't this be a lot better than four vehicles?

- The point on this topic is that we don't have the time or resources to work with the data. We currently have access to the A2Mac1 database (although it will be ending soon) and will be using it to determine some vehicle changes from our curb weight analyses. However the A2Mac1 database doesn't give detailed information on the different steel strengths used in the BIW (I think they have 10 BIW with analyses) and I understand Ducker gives an overview of how much of each steel is used by OEM, but not by vehicle.

I appreciate your view of the group to support EPA's baseline database development, and it is possible that we will come up with tasks for which we could use assistance – we just don't know yet at this time what that will be until we work with our database more – just a little shorthanded at the moment wrt timing of responding to you in a time efficient manner. As I mentioned above, please forward along your full vision for the group for it is likely I have not kept the full focus in mind as I was working to answer your question about the need for the A2Mac1 and Ducker databases.

John

On Jul 2, 2015, at 10:41 AM, "Caffrey, Cheryl" <caffrey.cheryl@epa.gov> wrote:

Hi John,

I wanted to give you an update on where we are with developing the baseline for mass reduction.

Currently the students have completed a near-final version of the database comparing curb weights of 2008 and 2014 MY vehicles. We have also noted the footprint for each vehicle and the overall vehicle dimensions with which we will use to analyze differences in curb weight along with noted vehicle changes (ex: body on frame to unibody, severe decontenting, etc.) in the two model years.

We have settled on this approach to date for several reasons.

1. The effective mass reduction is what is in the vehicle that is on the road (ie: curb weight). OEM's are in the habit of utilizing mass reduction to offset added mass from content or additional safety features and so even if one OEM added on a specific technology, it may have been offset by one of these factors.
2. The cost curves will likely be developed through detailed work with four specific vehicles (two pass cars and two trucks) and it is an approximation when applying these cost curves to other vehicles. OEM's have their own detailed plans for using mass reduction and overall costs will vary for each manufacturer – if the cost curves are clearly unrealistic then I believe the OEM's will let us know. However given comments from the MMLV project with Ford, Magna and DOE at the 2015 SAE World Congress this year it is apparent that even our cost estimates for some advanced technologies to date may be slightly overestimated – which we would expect as time marches on and more advancements are made.
3. The ability to understand the specific lightweight technologies on each vehicle would be a daunting task given the 1400 models and the information isn't readily

available (A2Mac1 has limited teardowns and Ducker Worldwide has some good information but not everything (from what I can tell – I haven't yet inquired with Ducker about the presentation they gave to the group).
4. The time to do this indepth analyses for each vehicle isn't available. We have three summer students working on gathering baseline information for the cub weight database and they are all leaving end of July/early August. The timeline for modeling inputs and draft write-ups are upon us with completion by December so we don't have unlimited time or resources.
5. We can review the methodology upon completion of the writeup and analyses for lightweighting and could adopt something for the Draft Determination in 2017.

I will keep you informed as we further work with our database and develop the baseline %MR for 2014. I will be out of the office Monday July 6 but will be in the rest of the week.

Thank you!
Cheryl Caffrey
734-214-4849

Cc: Anup Bandivadekar[anup@theicct.org]; John German[john@theicct.org]; Lutsey NIc[nic@theicct.org]
To: Caffrey, Cheryl[caffrey.cheryl@epa.gov]
From: Peter Mock
Sent: Thur 12/22/2016 9:18:18 AM
Subject: Re: Ricardo report for EU 2025-2030 - is it done?

Cheryl,

The EU is working on its light-duty CO2 standards regulation for the 2021-2030 timeframe. The Ricardo-AEA study that John forwarded you is part of their ongoing analyses. The file John forwarded is a draft version of the report, including draft cost curves, that was handed out to stakeholders in summer 2015. However, afterwards some significant staff changes within the responsible unit at the European Commission were carried out and since then the pace has considerably slowed down. The final version of the cost curve study has not been published yet. All that is available is a detailed set of spreadsheets with technology potential and cost assumptions. You can find those online here:
http://ec.europa.eu/clima/policies/transport/vehicles_en#tab-0-2
(the two links “Technology Results” and “Technology Sources” just below the row saying (Policy | Documentation | Studies)

The political timeline is as follows: The European Commission is expected to come forward with a regulatory proposal for how to extend the existing CO2 standards to the 2030 timeframe by mid/end-2017. Most likely outcome is that there will be a 2025/26 target and a 2030 target. It could however also be that they only set a 2030 target without any interim targets. After the European Commission proposal is out, the proposal needs to go through negotiations within the European Parliament and EU member states. This process typically takes about 1-1.5 years so we expect a final regulation at the earliest by end of 2018.

The file and the ICCT comments John forwarded to you are in the public domain, so please feel free to make use of them.

Regarding the issue of footprint vs. mass as utility parameter, this is one of the issues that will be looked at for the post-2020 regulation. From what I heard, an initial assessment of the Commission showed that the compliance cost using footprint as the parameter would be significantly lower than when using mass. However, there is fierce resistance from OEMs to change the system, so I wouldn’t be surprised if in the end the Commission would just stick to mass in the hope that it would make the political negotiations somewhat easier.

I hope this information is of help for you. Please do not hesitate to ask if you have any further questions. If you are interested, I could also introduce you to the regulators at the European Commission working on the post-2020 rule. I am sure they would be very interested in an exchange with you and your colleagues.

Best regards,

Peter

Dr. Peter Mock
Managing Director ICCT Europe
Neue Promenade 6, 10178 Berlin
+49 (30) 847129-102
peter@theicct.org

http://www.theicct.org
http://www.transportpolicy.net
http://eupocketbook.theicct.org

ICCT - International Council on Clean Transportation Europe gemeinnuetzige GmbH
Managing Director: Dr. Peter Mock, Amtsgericht Charlottenburg HRB 143557, VAT-IdNr. DE284186076
EU Transparency Register identification number: 06250094777-73

> On 21 Dec 2016, at 22:28, John German <john@theicct.org> wrote:
>
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>
> I don't think they are intending to revise mass adjustments to size.
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>> To: Caffrey, Cheryl <caffrey.cheryl@epa.gov>
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>> Cheryl
>> (734) 214-4849
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Cc: Nic Lutsey[nic@theicct.org]
To: Caffrey, Cheryl[caffrey.cheryl@epa.gov]
From: John German
Sent: Tue 12/20/2016 8:46:03 PM
Subject: Re: Technology papers - Lightweighting paper

Nic found the CA reference for me, Cheryl:
Appendix Q of CARB's 2012 ISOR:
https://www.arb.ca.gov/regact/2012/leviiighg2012/levappq.pdf

John

On Dec 20, 2016, at 2:32 PM, Caffrey, Cheryl <caffrey.cheryl@epa.gov> wrote:

Hi John!

Thank you for your input! Always good to have other points of view – especially since there are so many ways to view mass reduction. Whether an OEM does all optimization without changing material is one strategy, but based on presentations at Great Designs in Steel, it likely isn't the way they would approach this (again, my point of view). NHTSA's cost curves are all positive no matter where one is on the cost curve so we are an improvement on that viewpoint.

If you have a document for the CARB statement on costs of MR then that would be good and I can look it up online.

Thank you!
Cheryl

From: John German [mailto:john@theicct.org]
Sent: Tuesday, December 20, 2016 2:01 PM
To: Caffrey, Cheryl <caffrey.cheryl@epa.gov>
Subject: Re: Technology papers - Lightweighting paper

Thanks for reading it, Cheryl. Not many people go through the whole thing.

All of the technology working papers were always targeted at advancements since the rulemaking. It was quite an undertaking to obtain agreement from all of the participating suppliers on the contents, which was quite time consuming. And the process did not allow for revisions after the TAR was issued.

ICCT is preparing comments in response to the Proposed Determination. In this, we are updating the technology assessments from the working papers to compare with the ones in the Proposed Determination. So, this will likely be more in line with what you are looking for (although it will only be ICCT's position, not a joint position with suppliers).

The California reference was from CARB's technology assessment in support of their 2017-25 GHG standards. CARB disagreed with NHTSA and EPA on lightweighting cost and estimated it would only be $2.30/lb/%. I can dig this out if you want.

As for the lightweighting costs in the TAR (and the Proposed Determination). I think the studies upon which the costs are based are fine, but I disagree with how the study results have been used. (Note that this is my personal opinion - ICCT's comments on the Proposed Determination will not say anything about this - so please treat the following as confidential.)

- How can reducing weight by 5% reduce costs by $200? The answer is that most of this cost reduction isn't due to weight reduction, but rather better design. And better design can reduce costs by more than $200 if it is done without reducing weight. So, I think you have misstated the baseline for the costs of weight reduction.
- EPA's method implicitly assumes that the first 5% of weight reduction will be all better design - with no usage of higher cost materials - the next step would be all HSS, and the last step would be all aluminum. This isn't what history has shown - HSS, aluminum, and plastics have been increasing steadily in their use, and thus material costs should be averaged with better design, even for 5% weight reductions.

Thus, I think the cost estimate in our lightweighting technology working paper better reflects how lightweighting design and material development will actually take place in the fleet.

But, again, this is my opinion, not that of ICCT.

John

On Dec 20, 2016, at 1:14 PM, Caffrey, Cheryl <caffrey.cheryl@epa.gov> wrote:

Hi John!

Mike Olechiw forwarded me the paper on lightweighting (see below) that you sent to him yesterday. It is a very interesting read with all of the perspectives and information shared.

I did have a question on the reference lightweighting curve used in the paper. The paper used the FRM 2017-2025 linear 'curve' for mass reduction which was 4.36/lb*%MR. Could you let me know why you didn't use the cost curve information from the Draft TAR which is the latest cost curve utilized in the Midterm Review? It was quite different from the rulemaking FRM.

In consideration of the information in your paper, the paper said that the mass reduction costs would be for up to 15% lightweighting and would be 1/3 of the original rulemaking MR costs (4.36/lb*15%*2.2=1.44/kg, 1.44/3=0.48/kg) – and this would be for all vehicle types. The Draft TAR has different costs for passenger cars and light duty trucks. For Passenger Cars the Draft TAR included a baseline cost curve (where baseline is with 0% curb weight change between 2008 and 2015) in which it was a cost save (even GM noted cost savings in some vehicles over 10%). The Draft TAR also included description of the cost curve movement as the percent baseline increased (ie: if the 2015 model curb weight was less than the 2008 model curb weight). In this case if a passenger vehicle had 5% lighter curb weight in 2015 compared to 2008 then the cost curve would be adjusted upwards and the $/kg at 15% (for example) would be about $1.5/kg. For LDT: The 0% baseline cost curve MR cost was about $1.7 at 15% and would go up from there if any baseline %MR was present in the vehicle (ie: lighter in 2015 compared to 2008).

I am interested in your feedback on these Midterm Evaluation/Proposed Determination curves as well. I am also interested in your reference which says "California Air Resources Board (CARB) estimated lightweighting cost was only about half of this, $2.30/pound/% reduction" – what was this reference?

Thank you!
Cheryl Caffrey

Cost Curve for Pass Cars in Draft TAR:
(red curve) For vehicles with no decrease in curb weight between 2015 and 2008
(blue curve) For vehicles with 5% reduction in curb weight in 2015 compared to 2008 (about $1.6/kg)
<image001.jpg>

Cost curve for LDT in Draft TAR:
<image003.jpg>

From: Olechiw, Michael
Sent: Tuesday, December 20, 2016 6:50 AM
To: Caffrey, Cheryl <caffrey.cheryl@epa.gov>; Fernandez, Antonio <fernandez.antonio@epa.gov>; Safoutin, Mike <safoutin.mike@epa.gov>; McDonald, Joseph <McDonald.Joseph@epa.gov>; Bolon, Kevin <Bolon.Kevin@epa.gov>; Barba, Daniel <Barba.Daniel@epa.gov>; Kargul, John <kargul.john@epa.gov>; Moskalik, Andrew <Moskalik.Andrew@epa.gov>; Neam, Anthony <Neam.Anthony@epa.gov>; Cherry, Jeff <Cherry.Jeff@epa.gov>
Cc: Moran, Robin <moran.robin@epa.gov>
Subject: FW: Technology papers - Publication of Transmission Working Paper

ICCT Tech papers for your review.

Mike

From: John German [mailto:john@theicct.org]
Sent: Monday, December 19, 2016 3:38 PM
To: Charmley, William <charmley.william@epa.gov>; Olechiw, Michael <olechiw.michael@epa.gov>; Alson, Jeff <alson.jeff@epa.gov>; Alberto@ARB Ayala <Alberto.Ayala@arb.ca.gov>; Mike McCarthy <michael.mccarthy@arb.ca.gov>
Cc: Anup Bandivadekar <anup@theicct.org>; NIc Lutsey <nic@theicct.org>; Joe Schultz <joe@theicct.org>; Aaron Isenstadt <aaron.isenstadt@theicct.org>
Subject: Re: Technology papers - Publication of Transmission Working Paper

FYI, we just published our detailed working paper on lightweighting, written in cooperation with suppliers:

http://www.theicct.org/lightweighting-technology-development-and-trends-us-passenger-vehicles

Except for the diesel working paper, which we hope to publish in February, this is the last of our working papers. You can find the home page for all of the pages at:
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http://www.theicct.org/automotive-thermal-management-technology
http://www.theicct.org/PV-technology-transmissions-201608
http://www.theicct.org/naturally-aspirated-gas-engines-201606
http://www.theicct.org/hybrid-vehicles-trends-technology-development-and-cost-reduction

Please let me know if you have any questions or would like additional information.

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On Aug 29, 2016, at 2:29 PM, John German <john@theicct.org> wrote:

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The first paper is the detailed working paper that we did in collaboration with Eaton, BorgWarner, and ITB.
Working paper: <http://theicct.org/naturally-aspirated-gas-engines-201606>

The second is ICCT's technology "brief", which summarizes the results of the working paper and adds a bit about implications on the mid-term review.
Tech brief: <http://theicct.org/naturally-aspirated-engines-techbrief-jun2016>

Let me know if you have any questions or want additional information.

John

Cc: Hui He[hui@theicct.org]; Anup Bandivadekar[anup@theicct.org]
To: Caffrey, Cheryl[caffrey.cheryl@epa.gov]
From: John German
Sent: Tue 6/14/2016 1:40:09 PM
Subject: Re: Any information on CO2 emissions from coal powered aluminum plants in china v US?

I know nothing.
Hui/Anup - do either of you have a referral that might be able to answer Cheryl's question?

John

On Jun 14, 2016, at 8:58 AM, Caffrey, Cheryl <caffrey.cheryl@epa.gov> wrote:

Hey John!

We are wrapping up an LCA report review in prep for some comments on the TAR and I was wondering if you might have any information on the CO2 emissions from coal fired aluminum plants in China which are new versus the coal fired aluminum plants in the US which are older. If not then maybe you might have a referral.

I hope all is well.

Thank you for your time!
Cheryl Caffrey

To: Caffrey, Cheryl[caffrey.cheryl@epa.gov]
From: John German
Sent: Mon 8/31/2015 7:55:04 PM
Subject: Re: Can I use this slide in the Technical Assessment Report?

Just reference ICCT. I stole it from someone else here.
You might want to state that it is already out of date. For example, recent Chevy Cruise and Malibu both have large weight reductions.

John

On Aug 31, 2015, at 12:41 PM, "Caffrey, Cheryl" <caffrey.cheryl@epa.gov> wrote:

Hi John,

I would like to use this slide you had in your Asilomar presentation for the Technical Assessment Report for the MTE on mass reduction. Is it appropriate to reference you at ICCT for its source?

Appreciate your time.
Thank you!
Cheryl Caffrey

<image002.png>

<oledata.mso>

Cc: Ken White[slippery09@hotmail.co.uk]; Olechiw, Michael[olechiw.michael@epa.gov]
To: Caffrey, Cheryl[caffrey.cheryl@epa.gov]
From: John German
Sent: Thur 4/23/2015 7:20:12 PM
Subject: Fwd: US/EU/China lightweight vehicle technology study - Next call April 28

Unfortunately, Doug just shot down my idea of inviting Ducker and A2mac1 to give presentations (see below).
Can EPA at least talk in general terms about the kind of data they are likely to need, including baseline years desired (e.g. would you like 2010 to match the rulemaking and are you going to use an updated year for the MTE)? I would late to postpone the meeting, given that most of the main players have already committed and it will be 3 more weeks before I could reschedule.

John

Begin forwarded message:

From: "Richman, Doug" <Doug.Richman@kaiseral.com>
Subject: RE: US/EU/China lightweight vehicle technology study - Next call April 28
Date: April 23, 2015 3:14:19 PM EDT
To: "John German" <john@theicct.org>

John,
I recommend developing an initial consensus description of what we think we want before we start discussions with Ducker or A2mac1. This exercise will help us focus on clearly defined articulated project goals, objectives and scope. Contractors will then be in a position to propose the services they can provide to support those objectives. Contractors will, by the nature of their business, offer suggested revisions to the draft project description.
Doug

From: John German [mailto:john@theicct.org]
Sent: Thursday, April 23, 2015 1:53 PM
To: Richman, Doug
Cc: george.coates@thephxway.com Coates
Subject: Re: US/EU/China lightweight vehicle technology study - Next call April 28

Thanks, Doug.

A quick question about the agenda for April 28. Do you think it would be worthwhile to have Ducker and A2mac1 give brief presentations on April 28 and answer a few questions? Or should we try to hash out what we want first?

John

On Apr 23, 2015, at 1:35 PM, "Richman, Doug" <Doug.Richman@kaiseral.com>

wrote:

John,
I am available April 28 at 11 ET.
Doug Richman

From: John German [mailto:john@theicct.org]
Sent: Wednesday, April 22, 2015 3:25 PM
To: Michael Olechiw; Kevin Bolon; Cheryl Caffrey; Richman, Doug; Patrik Ragnarsson; Ed Opbroek; Russ Balzer; Jody R Shaw;george.coates@thephxway.com Coates; Ken White; Jan Guy; Amanda Kasik; Gina-Marie Oliver; Ingo.Sartorius@Plasticseurope.org; Patricia Vangheluwe; Pat Davis; Gong Huiming; Zhang Xiuli; 赵冬昶; 杨洁; 郭千里; lvwang@catarc.ac.cn; Ian Hodgson; Drew Kodjak; Hui He; Zifei Yang; Anup Bandivadekar; Peter Mock; Keri Browning
Subject: Re: US/EU/China lightweight vehicle technology study - Next call April 28

Although I have not heard back from most people and I have had two people say they cannot make April 28, I have decided to schedule the next meeting for April 28 (8am PT/11am ET/5pm ECT) for two reasons. First, the proposed date is only 6 days away and we need to get moving. Second, both EPA and Ian Hodgson (EC) are available on April 28 and I would like to focus the next call on the data requirements, which will be largely determined by the regulators from EPA, EU, and China.

ICCT will once again set up a GoToMeeting for April 28. We will distribute this before the end of the week.

I talked to Scott Ulnick at Ducker this morning. He gave me some background information on the type of data that they can supply and how the data can be stratified:

- Region: North America, EU-27, other EU, Japan, China, S. Korea, South America, India.
- Vehicle Components, such as body-in-white, closures, bumpers, powertrain
- Materials: Type of materials (e.g. metals, plastics) and grades
- Forming process, such as stamping, cast materials, etc.
- Geographic: Their data is stored by the location of the final assembly plant. They also have sales, so they can link to where the vehicles are sold, but this would cost more.
- Vehicle models: Typically sort their data by vehicle class, such as A, B, C. They can dive deeper into models and manufacturers, but would cost more.

Please come to the April 28 call prepared to discuss the level of detail needed for the data collection. This is an important step before we can proceed with discussions with Ducker and A2mac1 on supplying data and cost.

Following is a tentative agenda for the April 28 meeting. Let me know if you have comments or suggestions on agenda items:

Tentative Agenda for April 28:

1) Discuss level of detail needed for the data collection, for the parameters laid out by Ducker.

- Regions should be clear and I think we want the most detailed data possible on materials.
- Do we want data by component or forming process, or is an overall vehicle assessment adequate?
- Do we want data by vehicle model or manufacturer, or is market segment adequate?
- Do we want data by both both location of final assembly plant and by market location?
- EPA has requested an analysis of global platforms, so we need data on whether platform is local or global.

2) How does the data from A2mac1 overlap with that from Ducker? What unique data does each offer?

3) Who would like to be part of a group to discuss costs and contract proposals with Ducker and A2mac1?

4) How does data from the SAE-China Lightweight Alliance compare with these parameters? (Assuming SAE-China can make the call.)

John
734-355-1055

On Apr 20, 2015, at 5:59 PM, John German <john@theicct.org> wrote:

Existing studies: Two additional links:

- The European Aluminum Association has a public version of their latest Ducker report: http://www.alueurope.eu/wp-content/uploads/2012/04/EAA-Aluminium-Penetration-in-cars_Final-Report-Public-version.pdf
- A September 2014 report by the American Chemistry Council on "Plastics and Polymer Composites in Light Vehicles" is attached.

Next meeting. So far, I have only had feedback on the proposed April 28 meeting from EPA (yes), Ed Opbroek (yes), and Patrick Ragnarsson (no). Please let me know if April 28 works for you, so that we can get this scheduled or try to find a different time.

John

On Apr 17, 2015, at 2:42 PM, John German <john@theicct.org> wrote:

Thanks to everyone for participation in the kickoff meeting yesterday. We had a good discussion and helped lay out some parameters and next steps.

Notes from the meeting are attached. Note that I have reorganized this a bit, plus we have some additions and corrections from CATARC and SAE-China. Please let me know if you have any corrections or comments.

Next meeting. During the call, we tentatively discussed April 30. Unfortunately, EPA is not available on April 30 or the following week. They suggested that Tuesday, April 28 would be best for them. Please let me know your availability for April 28. Time would be the same - 8 PT/11ET/5 CET.

Existing studies:

- SAE Paper 2015-01-0574 on A2mac1 data and statistical methods by Malen & Hughes.

The authors are presenting this paper at next weeks SAE Congress in Detroit Thursday morning, Paper is available on the SAE website. Abstract is b elow.

- Plastics report is at: http://www.plastics-car.com/Tomorrows-Automobiles/Plastics-and-Polymer-Composites-Technology-Roadmap/Plastics-and-Polymer-Composites-Technology-Roadmap-for-Automotive-Markets-Full-Report.pdf
- Please send me links to any additional materials.

Next Steps:

- WorldAutoSteel will organize a briefing on the statistical methods used for the A2mac1 SAE paper.
- ICCT will follow up with EPA (and EU and CATARC?) to define the level of segregation they need for the data.
- ICCT will follow up with organizations that are interested but have not yet committed to participating.
- By next meeting hope to be able to define a scope of work, so we can request proposals.
- Any other suggestions?

John

On Apr 13, 2015, at 4:09 PM, John German <john@theicct.org> wrote:

Following is the GoToMeeting information for our meeting this Thursday. Please let me know if you need additional information - or if you have suggestions for the agenda (attached again).

1. Please join my meeting, Apr 16, 2015 at 8:00 AM PDT. https://global.gotomeeting.com/join/616257053

2. Use your microphone and speakers (VoIP) - a headset is recommended. Or, call in using your telephone.

United States: +1 (224) 501-3316
Germany: +49 (0) 692 5736 7207

Access Code: 616-257-053
Audio PIN: Shown after joining the meeting

Meeting ID: 616-257-053
John
734-355-1055

Begin forwarded message:

From: John German <john@theicct.org>
Subject: Re: US/EU/China lightweight vehicle technology study - kickoff meeting April 16
Date: March 31, 2015 10:16:04 AM EDT

Sorry to take so long to pick a date for our kickoff meeting. This is a group of busy people and it was hard to come up with a day everyone could participate.

The best compromise is Thursday, April 16, 8am PT, 11am ET, 5pm CET (thanks to the steel folks for being flexible). I will sent up a GoToMeeting and send this with the call-in information in a followup email. We have a lot to cover so please plan on two hours for the meeting.

Attached is a draft agenda, along with a preliminary list of project goals. This includes ICCT's original ideas (below) and some input from EPA and WorldAutoSteel. I would appreciate any additional suggestions on the agenda and items that you would like to discuss - including the specific tasks that your organization would like to support.

While the meeting is focused on the participants, I am also sending this email to a number of potential participants and other interested observers. We encourage you to join the meeting and participate as appropriate.

John

<Plastics in LD vehicles - Sep2014.pdf>

To: John German[john@theicct.org]
From: Caffrey, Cheryl
Sent: Tue 12/20/2016 7:32:31 PM
Subject: RE: Technology papers - Lightweighting paper

Hi John!

Thank you for your input! Always good to have other points of view – especially since there are so many ways to view mass reduction. Whether an OEM does all optimization without changing material is one strategy, but based on presentations at Great Designs in Steel, it likely isn't the way they would approach this (again, my point of view). NHTSA's cost curves are all positive no matter where one is on the cost curve so we are an improvement on that viewpoint.

If you have a document for the CARB statement on costs of MR then that would be good and I can look it up online.

Thank you!

Cheryl

From: John German [mailto:john@theicct.org]
Sent: Tuesday, December 20, 2016 2:01 PM
To: Caffrey, Cheryl <caffrey.cheryl@epa.gov>
Subject: Re: Technology papers - Lightweighting paper

Thanks for reading it, Cheryl. Not many people go through the whole thing.

All of the technology working papers were always targeted at advancements since the rulemaking. It was quite an undertaking to obtain agreement from all of the participating suppliers on the contents, which was quite time consuming. And the process did not allow for revisions after the TAR was issued.

ICCT is preparing comments in response to the Proposed Determination. In this, we are updating the technology assessments from the working papers to compare with the ones in the Proposed Determination. So, this will likely be more in line with what you are looking for (although it will only be ICCT's position, not a joint position with suppliers).

The California reference was from CARB's technology assessment in support of their 2017-25 GHG standards. CARB disagreed with NHTSA and EPA on lightweighting cost and estimated it would only be $2.30/lb/%. I can dig this out if you want.

As for the lightweighting costs in the TAR (and the Proposed Determination). I think the studies upon which the costs are based are fine, but I disagree with how the study results have been used. (Note that this is my personal opinion - ICCT's comments on the Proposed Determination will not say anything about this - so please treat the following as confidential.)

- How can reducing weight by 5% reduce costs by $200? The answer is that most of this cost reduction isn't due to weight reduction, but rather better design. And better design can reduce costs by more than $200 if it is done without reducing weight. So, I think you have misstated the baseline for the costs of weight reduction.
- EPA's method implicitly assumes that the first 5% of weight reduction will be all better design - with no usage of higher cost materials - the next step would be all HSS, and the last step would be all aluminum. This isn't what history has shown - HSS, aluminum, and plastics have been increasing steadily in their use, and thus material costs should be averaged with better design, even for 5% weight reductions.

Thus, I think the cost estimate in our lightweighting technology working paper better reflects how lightweighting design and material development will actually take place in the fleet.

But, again, this is my opinion, not that of ICCT.

John

On Dec 20, 2016, at 1:14 PM, Caffrey, Cheryl <caffrey.cheryl@epa.gov> wrote:

Hi John!

Mike Olechiw forwarded me the paper on lightweighting (see below) that you sent to him yesterday. It is a very interesting read with all of the perspectives and information shared.

I did have a question on the reference lightweighting curve used in the paper. The paper used the FRM 2017-2025 linear 'curve' for mass reduction which was 4.36/lb*%MR. Could you let me know why you didn't use the cost curve information from the Draft TAR which is the latest cost curve utilized in the Midterm Review? It was quite different from the rulemaking FRM.

In consideration of the information in your paper, the paper said that the mass reduction costs would be for up to 15% lightweighting and would be 1/3 of the original rulemaking MR costs (4.36/lb*15%*2.2=1.44/kg, 1.44/3=0.48/kg) – and this would be for all vehicle types. The Draft TAR has different costs for passenger cars and light duty trucks. For Passenger Cars the Draft TAR included a baseline cost curve (where baseline is with 0% curb weight change between 2008 and 2015) in which it was a cost save (even GM noted cost savings in some vehicles over 10%). The Draft TAR also included description of the cost curve movement as the percent baseline increased (ie: if the 2015 model curb weight was less than the 2008 model curb weight). In this case if a passenger vehicle had 5% lighter curb weight in 2015 compared to 2008 then the cost curve would be adjusted upwards and the $/kg at 15% (for example) would be about $1.5/kg. For LDT: The 0% baseline cost curve MR cost was about $1.7 at 15% and would go up from there if any baseline %MR was present in the vehicle (ie: lighter in 2015 compared to 2008).

I am interested in your feedback on these Midterm Evaluation/Proposed Determination curves as well. I am also interested in your reference which says "California Air Resources Board (CARB) estimated lightweighting cost was only about half of this, $2.30/pound/% reduction" – what was this reference?

Thank you!

Cheryl Caffrey

Cost Curve for Pass Cars in Draft TAR:

(red curve) For vehicles with no decrease in curb weight between 2015 and 2008

(blue curve) For vehicles with 5% reduction in curb weight in 2015 compared to 2008 (about $1.6/kg)

<image001.jpg>

Cost curve for LDT in Draft TAR:

<image003.jpg>

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Sent: Tuesday, December 20, 2016 6:50 AM
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Let me know if you have any questions or want additional information.

John

To: John German[john@theicct.org]
From: Caffrey, Cheryl
Sent: Tue 12/20/2016 6:14:47 PM
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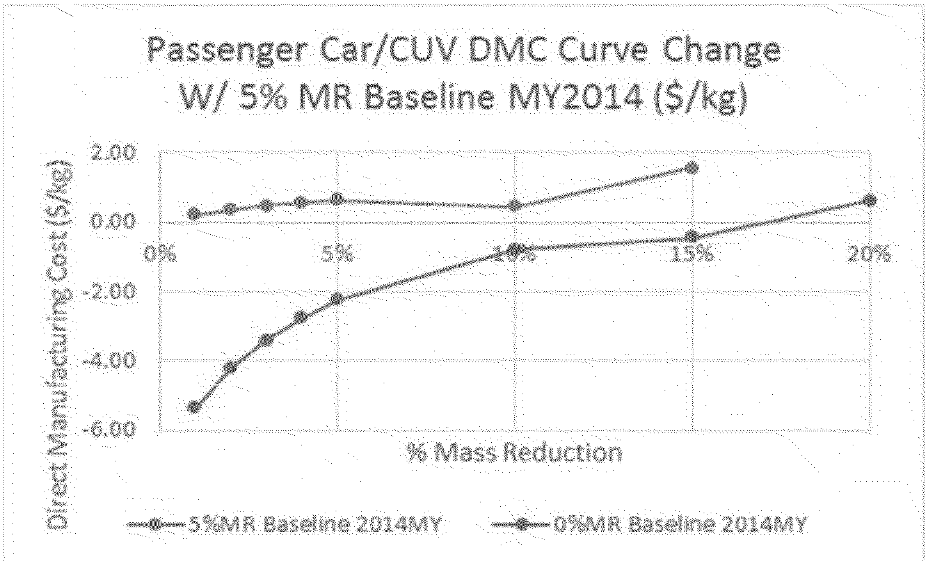

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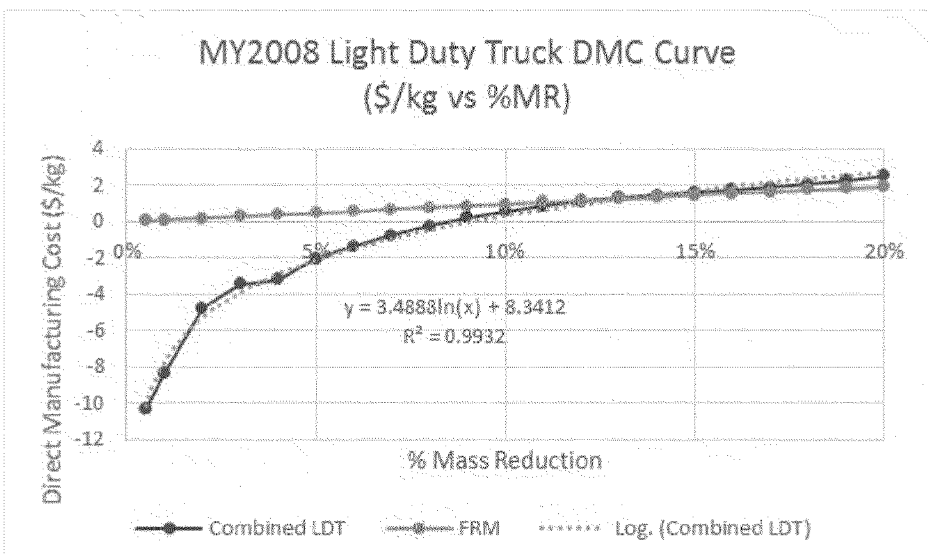

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Subject: Re: Technology papers - Publication of Transmission Working Paper

FYI, we just published our detailed working paper on lightweighting, written in cooperation with suppliers:

http://www.theicct.org/lightweighting-technology-development-and-trends-us-passenger-vehicles

Except for the diesel working paper, which we hope to publish in February, this is the last of our working papers. You can find the home page for all of the pages at:

http://www.theicct.org/series/us-passenger-vehicle-technology-trends

Note that the page includes both the detailed working papers we wrote with suppliers and the shorter ICCT technology briefs, so most of the subjects are listed twice.

Specific web links for the other detailed technology working papers are as follows:

http://www.theicct.org/downsized-boosted-gasoline-engines

http://www.theicct.org/automotive-thermal-management-technology

http://www.theicct.org/PV-technology-transmissions-201608

http://www.theicct.org/naturally-aspirated-gas-engines-201606

http://www.theicct.org/hybrid-vehicles-trends-technology-development-and-cost-reduction

Please let me know if you have any questions or would like additional information.

John

On Aug 29, 2016, at 2:29 PM, John German <john@theicct.org> wrote:

FYI, we just published our second detailed technology working paper, this one on transmissions. Dana, BorgWarner, ITB, and FEV contributed to this paper:

http://www.theicct.org/PV-technology-transmissions-201608

Unfortunately, we have not yet finished ICCT's technology "brief" on transmissions, summarizing the results and adding a bit about implications on the mid-term review. I will let you know when this has been completed.

The papers on gasoline turbocharged engines and thermal management have finished supplier review and are now undergoing a final internal review by our communications team. The lightweighting paper was sent out for supplier review on Aug. 10, with their comments due by August 31. We are still hopeful that these can be finished by the end of September, with the paper on diesels following by the end of the year.

John

On Jun 21, 2016, at 10:51 AM, John German <john@theicct.org> wrote:

FYI, we just published two papers on naturally aspirated gasoline engines. These are the first in a series of technology reports in support of the 2017-25 mid-term review. Reports on transmissions, gasoline turbocharged engines, lightweighting, and thermal management will (hopefully) be finished by September, with a report on diesels following by the end of the year.

The first paper is the detailed working paper that we did in collaboration with Eaton, BorgWarner, and ITB.

Working paper: <http://theicct.org/naturally-aspirated-gas-engines-201606>

The second is ICCT's technology "brief", which summarizes the results of the working paper and adds a bit about implications on the mid-term review.
Tech brief: <http://theicct.org/naturally-aspirated-engines-techbrief-jun2016>

Let me know if you have any questions or want additional information.

John

To: John German[john@theicct.org]
Cc: Hui He[hui@theicct.org]; Anup Bandivadekar[anup@theicct.org]
From: Caffrey, Cheryl
Sent: Tue 6/14/2016 3:30:38 PM
Subject: RE: Any information on CO_2 emissions from coal powered aluminum plants in china v US?

All,

Thank you all for your time and consideration. I was able to come across some information.

I hope all is well with you all!

Cheryl Caffrey

From: John German [mailto:john@theicct.org]
Sent: Tuesday, June 14, 2016 9:40 AM
To: Caffrey, Cheryl <caffrey.cheryl@epa.gov>
Cc: Hui He <hui@theicct.org>; Anup Bandivadekar <anup@theicct.org>
Subject: Re: Any information on CO_2 emissions from coal powered aluminum plants in china v US?

I know nothing.

Hui/Anup - do either of you have a referral that might be able to answer Cheryl's question?

John

On Jun 14, 2016, at 8:58 AM, Caffrey, Cheryl <caffrey.cheryl@epa.gov> wrote:

Hey John!

We are wrapping up an LCA report review in prep for some comments on the TAR and I was wondering if you might have any information on the CO2 emissions from coal fired aluminum plants in China which are new versus the coal fired aluminum plants in the US which are older. If not then maybe you might have a referral.

I hope all is well.

Thank you for your time!

Cheryl Caffrey

To: John German[john@theicct.org]
From: Caffrey, Cheryl
Sent: Tue 6/14/2016 12:58:55 PM
Subject: Any information on CO2 emissions from coal powered aluminum plants in china v US?

Hey John!

We are wrapping up an LCA report review in prep for some comments on the TAR and I was wondering if you might have any information on the CO2 emissions from coal fired aluminum plants in China which are new versus the coal fired aluminum plants in the US which are older. If not then maybe you might have a referral.

I hope all is well.

Thank you for your time!

Cheryl Caffrey

To: John German[john@theicct.org]
From: Caffrey, Cheryl
Sent: Mon 8/31/2015 8:20:23 PM
Subject: RE: Can I use this slide in the Technical Assessment Report?

AOK – will do. Thanks!

Cheryl

From: John German [mailto:john@theicct.org]
Sent: Monday, August 31, 2015 3:55 PM
To: Caffrey, Cheryl
Subject: Re: Can I use this slide in the Technical Assessment Report?

Just reference ICCT. I stole it from someone else here.

You might want to state that it is already out of date. For example, recent Chevy Cruise and Malibu both have large weight reductions.

John

On Aug 31, 2015, at 12:41 PM, "Caffrey, Cheryl" <caffrey.cheryl@epa.gov> wrote:

> Hi John,
>
> I would like to use this slide you had in your Asilomar presentation for the Technical Assessment Report for the MTE on mass reduction. Is it appropriate to reference you at ICCT for its source?
>
> Appreciate your time.

Thank you!

Cheryl Caffrey

<image002.png>

<oledata.mso>

To: John German[john@theicct.org]
From: Caffrey, Cheryl
Sent: Mon 8/31/2015 4:41:59 PM
Subject: Can I use this slide in the Technical Assessment Report?

Hi John,

I would like to use this slide you had in your Asilomar presentation for the Technical Assessment Report for the MTE on mass reduction. Is it appropriate to reference you at ICCT for its source?

Apprcciatc your timc.

Thank you!

Cheryl Caffrey

Vehicle make	Model year	Weight reduction (kg)*	Weight reduction (%)*	Designed market
Ford F150	2015	318	14%	US
Acura MDX	2014	111	5%	US
GM Cadillac CTS	2014	111	6%	US
Peugeot 308 SW Blue Hdi	2014	140	9%	EU
VW Golf TDI	2015	49	4%	EU
Audi Q7	2014	363	15%	US, EU
BMW i3 EV	2014	249	17%	US, EU
Land Rover Range Rover	2014	350	14%	US, EU
Porsche Cayenne	2012	181	8%	US, EU
Audi A8	2014	145	7%	US, EU
Audi A3	2014	80	6%	US, EU
Nissan Leaf	2012	80	5%	US, EU
Lamborghini Huracan	2015	78	5%	US, EU
Audi TT 3rd gen 2.0 TDI	2015	50	4%	US, EU

To: John German[john@theicct.org]
From: Caffrey, Cheryl
Sent: Tue 8/18/2015 7:15:51 PM
Subject: Fw: Presentations from Aachen Body Engineering Days 2014 conference - may not be available for public release

Hi John!

I have been talking with Robin Moran in regards to your presentation tomorrow at the conference and I found the information on the 2016 Cruze very interesting. I followed up with the conference you referenced for this information and received the following response - which indicates that the information isn't released for public use. I am sure you checked this out already but wanted to let you know what I received.

Thank you!

Cheryl

From: Kristian Seidel <seidel@fka.de>
Sent: Tuesday, August 18, 2015 5:37 AM
To: Caffrey, Cheryl
Subject: WG: Presentations from Aachen Body Engineering Days 2014 conference

Dear Mrs. Caffrey,

the Delta platform (basis for the Cruze) has actually been discussed during our conference. Unfortunately the presentation has not been released for publication though and is not part of the proceedings. You might be able to contact the speaker Mr. Dipl.-Ing. Michael Küpper, Adam Opel AG and Dipl.-Ing. Peter Eckhardt, Adam Opel AG, but due to confidentiality I cannot give you any contact details.

I hope this will help you with your research. Please feel free to contact me for further questions. Here I would also like to draw your attention to our consulting activities within our strategy department (http://www.fka.de/consulting/consulting-e.php?ebene1=d-e&ebene2=d1-e).

Best regards

Kristian Seidel

Dipl.-Ing. Kristian Seidel

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Tel +49 241 8861 122 - Mobil +49 163 2016476 - Fax +49 241 8861 110

seidel@fka.de - www.fka.de

Von: Caffrey, Cheryl [mailto:caffrey.cheryl@epa.gov]
Gesendet: Montag, 17. August 2015 20:00
An: Markus Bröckerhoff
Betreff: Presentations from Aachen Body Engineering Days 2014 conference

Hello Dr. –Ing. Markus Brockerhoff,

My name is Cheryl Caffrey and I work for the US EPA National Vehicle and Fuels Emissions Laboratory in Ann Arbor Michigan. I recently became aware of your conference held last September in Aachen on Body Engineering. I also learned that at this conference the lightweighting of the 2016 Chevy Cruze was discussed. I am currently writing the lightweighting section for the Midterm Evaluation of US EPA's Light Duty Greenhouse gas 2022-2025 standards and would like to see if I can get a copy of this presentation or the name of the presenter to whom I can contact and request a copy.

Site for conference:

http://www.fka.de/Academy/aachener-karosserietage-2014-e/index.php?ebene1=f-e&ebene2=f2-e&path=./&page=0

I appreciate any assistance you can provide.

Thank you!

Cheryl Caffrey

US EPA NVFEL
Mechanical Engineer, MS

(734) 214-4849

Bcc: jrege@globalautomakers.org[jrege@globalautomakers.org]; Klomp, Ryan[ryan.klomp@tc.gc.ca]; Meyer, Norm[norm.meyer@tc.gc.ca]; Davidson,Josephine [NCR][Josephine.Davidson@ec.gc.ca]; Abey Abraham[abeya@ducker.com]; Kelly, Jarod Cory[jckelly@anl.gov]; gschroeder@cargroup.org[gschroeder@cargroup.org]; besterberg@cargroup.org[besterberg@cargroup.org]; Jay Baron[jbaron@CARGROUP.ORG]; John German[john@theicct.org]; Jody Hall[jhall@steel.org]; Richman, Doug[Doug.Richman@kaiseral.com]; Schutte, Carol[Carol.Schutte@ee.doe.gov]; Barbara Kiss[barbara.kiss@gm.com]; john.catterall@gm.com[john.catterall@gm.com]; mkozdras@RNCan.gc.ca[mkozdras@RNCan.gc.ca]; mzaluzec@ford.com[mzaluzec@ford.com]; dwagner6@ford.com[dwagner6@ford.com]; dmalen@umich.edu[dmalen@umich.edu]; tshaw@leandesign.com[tshaw@leandesign.com]; edopbroek@worldautosteel.org[edopbroek@worldautosteel.org]; jhughes@a2mac1.com[jhughes@a2mac1.com]
From: Caffrey, Cheryl
Sent: Wed 7/15/2015 5:41:24 PM
Subject: Available online: Mass Reduction and Cost Analysis - Light Duty Pickup Trucks Model Years 2020-2025

Dear Colleague,

We are proud to inform you that the lightweighting study on the Light Duty Pickup Truck by FEV North America, EDAG and Munro & Associates is now on the EPA website at http://www.epa.gov/otaq/climate/mte.htm#epa-projects (direct link to report is at

http://www.epa.gov/otaq/climate/documents/mte/420r15006.pdf).

We greatly appreciate all of the information you all have shared with us in regards to the ideas on lightweighting whether it be related to this report or the lightweighting topic in general and ICCT for the financial sponsorship of the suspension section of this report. In addition to the report, the online site contains the CAE baseline and lightweight models. We expect the Peer Review Response to Comment Report to be placed on the website by July 24.

A followup study from this work is underway and focuses on the change in mass needed for the lightweight design to meet the IIHS small overlap. This work is being done by Transport Canada and EDAG and is expected to be available in October of 2015. This work incorporates the lightweight ideas contained in the LDT study by FEV/EDAG/Munro and modifications to the model as needed.

Sincerely,

Cheryl Caffrey

US EPA NVFEL

Mechanical Engineer, MS

734-214-4849

To: John German[john@theicct.org]
From: Caffrey, Cheryl
Sent: Thur 4/23/2015 8:07:26 PM
Subject: RE: US/EU/China lightweight vehicle technology study - Next call April 28

Sure – and maybe address some of the other questions – like global material issues, etc.

Cheryl

From: John German [mailto:john@theicct.org]
Sent: Thursday, April 23, 2015 3:04 PM
To: Caffrey, Cheryl
Cc: Bolon, Kevin; Olechiw, Michael
Subject: Re: US/EU/China lightweight vehicle technology study - Next call April 28

At this stage, probably can't delay. Especially since Mike indicated he wasn't available the week of May 4 and I will be in China the week of May 11 (I scheduled for April 28 at Mike's request).

I could revise the agenda, to try to get Ducker and A2mac1 to call in and give short presentations and take some Q&A.

John

On Apr 23, 2015, at 2:54 PM, "Caffrey, Cheryl" <caffrey.cheryl@epa.gov> wrote:

Hi John,

Thank you for all of your excitement in getting this project moving. However I do think we are moving a bit too quickly.

Currently we are in the process of examining the baseline methodology we have in mind for the MTE and are not yet sure how detailed vehicle data is going to be a part of the methodology. We need at least a week or maybe even two in order to evaluate our current methodology and determine how detailed data, such as that provided by A2Mac1, is going to fit into it.

Let me know if you can delay.

Thank you!

Cheryl Caffrey

From: John German [mailto:john@theicct.org]
Sent: Wednesday, April 22, 2015 3:25 PM
To: Olechiw, Michael; Bolon, Kevin; Caffrey, Cheryl; Doug Richman; Patrik Ragnarsson; Ed Opbroek; Russ Balzer; Jody R Shaw;george.coates@thephxway.com Coates; Ken White; Jan Guy; Amanda Kasik; Gina-Marie Oliver; Ingo.Sartorius@Plasticseurope.org; Patricia Vangheluwe; Pat Davis; Gong Huiming; Zhang Xiuli; ÕÔ¶¬êÆ; Ñî½à; ¹ùÇ§Àï; lvwang@catarc.ac.cn; Ian Hodgson; Drew Kodjak; Hui He; Zifei Yang; Anup Bandivadekar; Peter Mock; Keri Browning
Subject: Re: US/EU/China lightweight vehicle technology study - Next call April 28

Although I have not heard back from most people and I have had two people say they cannot make April 28, I have decided to **schedule the next meeting for April 28 (8am PT/11am ET/5pm ECT)** for two reasons. First, the proposed date is only 6 days away and we need to get moving. Second, both EPA and Ian Hodgson (EC) are available on April 28 and **I would like to focus the next call on the data requirements,** which will be largely determined by the regulators from EPA, EU, and China.

ICCT will once again set up a GoToMeeting for April 28. We will distribute this before the end of the week.

I talked to Scott Ulnick at Ducker this morning. He gave me some background information on the type of data that they can supply and how the data can be stratified:

- **Region**: North America, EU-27, other EU, Japan, China, S. Korea, South America, India.
- **Vehicle Components,** such as body-in-white, closures, bumpers, powertrain
- **Materials**: Type of materials (e.g. metals, plastics) and grades
- **Forming process**, such as stamping, cast materials, etc.

- **Geographic:** Their data is stored by the location of the final assembly plant. They also have sales, so they can link to where the vehicles are sold, but this would cost more.
- **Vehicle models:** Typically sort their data by vehicle class, such as A, B, C. They can dive deeper into models and manufacturers, but would cost more.

Please come to the April 28 call prepared to **discuss the level of detail needed for the data collection**. This is an important step before we can proceed with discussions with Ducker and A2mac1 on supplying data and cost.

Following is a tentative agenda for the April 28 meeting. Let me know if you have comments or suggestions on agenda items:

Tentative Agenda for April 28:

1) Discuss level of detail needed for the data collection, for the parameters laid out by Ducker.

- Regions should be clear and I think we want the most detailed data possible on materials.
- Do we want data by component or forming process, or is an overall vehicle assessment adequate?
- Do we want data by vehicle model or manufacturer, or is market segment adequate?
- Do we want data by both both location of final assembly plant and by market location?
- EPA has requested an analysis of global platforms, so we need data on whether platform is local or global.

2) How does the data from A2mac1 overlap with that from Ducker? What unique data does each offer?

3) Who would like to be part of a group to discuss costs and contract proposals with Ducker and A2mac1?

4) How does data from the SAE-China Lightweight Alliance compare with these parameters? (Assuming SAE-China can make the call.)

John

734-355-1055

On Apr 20, 2015, at 5:59 PM, John German <john@theicct.org> wrote:

Existing studies: Two additional links:

- The European Aluminum Association has a public version of their latest Ducker report: http://www.alueurope.eu/wp-content/uploads/2012/04/EAA-Aluminium-Penetration-in-cars_Final-Report-Public-version.pdf
- A September 2014 report by the American Chemistry Council on "Plastics and Polymer Composites in Light Vehicles" is attached.

Next meeting. So far, I have only had feedback on the proposed April 28 meeting from EPA (yes), Ed Opbroek (yes), and Patrick Ragnarsson (no). **Please let me know if April 28 works for you**, so that we can get this scheduled or try to find a different time.

John

On Apr 17, 2015, at 2:42 PM, John German <john@theicct.org> wrote:

Thanks to everyone for participation in the kickoff meeting yesterday. We had a good discussion and helped lay out some parameters and next steps.

Notes from the meeting are attached. Note that I have reorganized this a bit, plus we have some additions and corrections from CATARC and SAE-China. **Please let me know if you have any corrections or comments.**

Next meeting. During the call, we tentatively discussed April 30. Unfortunately, EPA is not available on April 30 or the following week. They suggested that Tuesday, April 28 would be best for them. **Please let me know your availability for April 28.** Time would be the same - 8 PT/11ET/5 CET.

Existing studies:

- SAE Paper 2015-01-0574 on A2mac1 data and statistical methods by Malen & Hughes.

The authors are presenting this paper at next week¡¯s SAE Congress in Detroit ¨C Thursday morning, Paper is available on the SAE website. Abstract is b

elow.

- Plastics report is at: http://www.plastics-car.com/Tomorrows-Automobiles/Plastics-and-Polymer-Composites-Technology-Roadmap/Plastics-and-Polymer-Composites-Technology-Roadmap-for-Automotive-Markets-Full-Report.pdf
- **Please send me links to any additional materials.**

Next Steps:

- WorldAutoSteel will organize a briefing on the statistical methods used for the A2mac1 SAE paper.
- ICCT will follow up with EPA (and EU and CATARC?) to define the level of segregation they need for the data.
- ICCT will follow up with organizations that are interested but have not yet committed to participating.
- By next meeting hope to be able to define a scope of work, so we can request proposals.
- **Any other suggestions?**

John

On Apr 13, 2015, at 4:09 PM, John German <john@theicct.org> wrote:

Following is the GoToMeeting information for our meeting this Thursday. Please let me know if you need additional information - or if you have suggestions for the agenda (attached again).

1. Please join my meeting, Apr 16, 2015 at 8:00 AM PDT.
https://global.gotomeeting.com/join/616257053

2. Use your microphone and speakers (VoIP) - a headset is recommended. Or, call in using your telephone.

United States: +1 (224) 501-3316
Germany: +49 (0) 692 5736 7207

Access Code: 616-257-053
Audio PIN: Shown after joining the meeting

Meeting ID: 616-257-053

John

734-355-1055

Begin forwarded message:

From: John German <john@theicct.org>

Subject: Re: US/EU/China lightweight vehicle technology study - kickoff meeting April 16

Date: March 31, 2015 10:16:04 AM EDT

Sorry to take so long to pick a date for our kickoff meeting. This is a group of busy people and it was hard to come up with a day everyone could participate.

The best compromise is **Thursday, April 16, 8am PT, 11am ET, 5pm CET** (thanks to the steel folks for being flexible). I will sent up a GoToMeeting and send this with the call-in information in a followup email. We have a lot to cover so please plan on **two hours for the meeting**.

Attached is a draft agenda, along with a preliminary list of project goals. This includes ICCT's original ideas (below) and some input from EPA and WorldAutoSteel. **I would appreciate any additional suggestions on the agenda and items that you would like to discuss - including the specific tasks that your organization would like to support.**

While the meeting is focused on the participants, I am also sending this email to a number of potential participants and other interested observers. We encourage you to join the meeting and participate as appropriate.

John

<Plastics in LD vehicles - Sep2014.pdf>

From: blair.anderson@dot.gov
Location: DOT HQ - W40-300 - 1200 New Jersey Avenue, SE, Washington, DC 20590
Importance: Normal
Subject: Meeting: TAR Mid-Term Evaluation
Categories: Purple Category
Start Date/Time: Mon 5/23/2016 5:00:00 PM
End Date/Time: Mon 5/23/2016 6:00:00 PM

...
,,,
If you need to call into this meeting please use the call-in number below
Ex. 6 - Personal Privacy
Please be sure that all members of your group have their US Government Issued ID to clear security.
Upon arrival please call 202-366-2775 and I will escort you to the conference room once your have cleared security.
Thank you
Heather Laca
Administrative Staff Assistant
Department Of Transportation
National Highway Traffic Safety Administration
1200 New Jersey Avenue, SE, W40-304
Washington, DC 20590
Office – 202-366-2775
From: Jonna Hamilton [mailto:JHamilton@ucsusa.org]
Sent: Wednesday, April 27, 2016 2:17 PM
To: mccabe.janet@epa.gov; mark.rosekind@dot.gov; Corey, Richard@ARB
Cc: Atkinson.emily@epa.gov; hengst.benjamin@epa.gov; yvonne.e.clarke@dot.gov; Ayala, Alberto@ARB
Subject: Meeting request
Dear Assistant Administrator McCabe, Administrator Rosekind, and Mr. Corey,
On behalf of the NGO communities that represent environmental organizations, consumer groups, national security groups, and business groups, I would like to request a meeting in May to discuss the mid-term evaluation and specifically the upcoming Technical Assessment Report (TAR) that is due out in June of this year. Our organizations would like to learn more about your approach to the mid-term evaluation process and the TAR and share our view on the mid-term evaluation as well as preview some additional analysis that we are working on.
We look forward to talking with you.
Thank you,
Jonna Hamilton

Jonna Hamilton
Senior Washington Representative
Clean Vehicles Program
Union of Concerned Scientists
1825 K Street NW, Suite 800
Washington, DC 20001
202-331-5451
JHamilton@ucsusa.org

To: Charmley, William[charmley.william@epa.gov]
From: Nic Lutsey
Sent: Tue 10/25/2016 4:35:00 PM
Subject: Re: Check in call on ICCT analysis

Hi Bill,

Yep, that'd be perfect. Thanks.

Nic

> On Oct 25, 2016, at 9:33 AM, Charmley, William <charmley.william@epa.gov> wrote:
>
> Nic
>
> Can I call you on my drive home, say around 5:30pm east coast time?
>
> Thanks
> Bill
>
>
> Sent from my iPhone
>
>> On Oct 21, 2016, at 11:36 AM, Nic Lutsey <nic@theicct.org> wrote:
>>
>> Hi Bill,
>>
>> Great, thanks (and sorry for the delayed response…), I'm glad to give you our detailed thinking on timing etc. Please feel free to call me whenever today or Monday at 415-202-5743 (office) and Ex. 6 - Personal Privacy Ex. 6 - Personal Privacy I've cc-ed JoNell, in case it's easier to pin down a 15 min slot in your calendar. Thanks in advance.
>>
>> Nic
>>
>>> On Oct 17, 2016, at 12:07 PM, Charmley, William <charmley.william@epa.gov> wrote:
>>>
>>> Nic -
>>>
>>>
>>> Can I give you a call on this - I have a few background questions on the ICCT work, including timing, and then Mike can follow-up with you to discuss how we can help from a logistics perspective.
>>>
>>>
>>> Thanks
>>> Bill
>>>
>>>
>>> -----Original Message-----
>>> From: Nic Lutsey [mailto:nic@theicct.org]
>>> Sent: Monday, October 17, 2016 2:41 PM
>>> To: Charmley, William <charmley.william@epa.gov>; Olechiw, Michael <olechiw.michael@epa.gov>
>>> Subject: Check in call on ICCT analysis
>>>
>>> Hi Mike and Bill,
>>>
>>> I hope all is going great for you two. Congrats on the great body of work you released with the TAR. I

can't say I've read through everything, but I've probably read through more of it than most. The ICCT is chipping away a few projects, including John's tech briefing series — and now a new major analysis to report on technology potential for 2025-2030 for our global CO2 analysis.
>>>
>>> We think the best starting point for our 2025-2030 analysis is the TAR technology inputs, and the best modeling basis is to use the OMEGA platform. We wanted to reach out to try to schedule a short call to explain the project's approach and get input from your team on the use of the OMEGA modeling system. We are already well trained (we've worked with Ari over the years) and now have OMEGA 2016 up and running. At this point, ensuring that any of our modified technology inputs run through the TEB-CEB machine, lumped parameter, etc for the OMEGA modeling is a key remaining question for us.
>>>
>>> Might we be able to schedule a call in the Oct 24-28, Oct 31- Nov 1 period? I think a call between our team and Mike, Todd, and others for 60 minutes would be extremely helpful to make sure we understand the final file preparation of OMEGA runs. Of course feel free to re-direct us to the applicable team members as you see fit. Here are my numbers if more context would help: 415-202-5743 (office) and Ex. 6 - Personal Privacy
Ex. 6 - Personal Privacy
>>>
>>> Nic
>>

To: Charmley, William[charmley.william@epa.gov]
From: John German
Sent: Tue 5/24/2016 6:42:14 PM
Subject: Re: I left you a voice-mail

Yes, we have the conference room scheduled from 9:30 to 12:30, so happy to host the meeting here at ICCT.
John

On May 24, 2016, at 1:53 PM, Charmley, William <charmley.william@epa.gov> wrote:

John,

I have spoken with Chet, Siddiq and Davd – they are all available tomorrow morning at 9:30.

Can you host this meeting at ICCT? I think it would just be the 5 of us.

Thanks
Bill

From: John German [mailto:john@theicct.org]
Sent: Tuesday, May 24, 2016 1:15 PM
To: Charmley, William <charmley.william@epa.gov>
Subject: Re: I left you a voice-mail

Yes, I am available at 9:30 tomorrow.

I in a call now, but I will call you when I get a chance.

John

On May 24, 2016, at 1:12 PM, Charmley, William <charmley.william@epa.gov> wrote:

Regarding tomorrow in D.C.

I will be in DC tomorrow, and from 10:30-12:30 I will be at ICCT for a meeting with Drew

Are you available in the morning, say from 9:30 – 10:30, to catch up on some light-duty MTE topics? If yes, I might invite Chet France from EDF, Siddiq from ACEEE, and Dave Cook from UCS to the ICCT offices for a discussion along with you on the

MTE.

Please give me a call if you have a few minutes at 734-214-4466.

Thanks
Bill

To: Charmley, William[charmley.william@epa.gov]
From: John German
Sent: Tue 5/24/2016 5:14:51 PM
Subject: Re: I left you a voice-mail

Yes, I am available at 9:30 tomorrow.
I in a call now, but I will call you when I get a chance.

John

On May 24, 2016, at 1:12 PM, Charmley, William <charmley.william@epa.gov> wrote:

Regarding tomorrow in D.C.

I will be in DC tomorrow, and from 10:30-12:30 I will be at ICCT for a meeting with Drew

Are you available in the morning, say from 9:30 – 10:30, to catch up on some light-duty MTE topics? If yes, I might invite Chet France from EDF, Siddiq from ACEEE, and Dave Cook from UCS to the ICCT offices for a discussion along with you on the MTE.

Please give me a call if you have a few minutes at 734-214-4466.

Thanks
Bill

To: Charmley, William[charmley.william@epa.gov]; Amerling, Kristin (OST)[kristin.amerling@dot.gov]; Atkinson, Emily[Atkinson.Emily@epa.gov]; carolina.zavala@arb.ca.gov[carolina.zavala@arb.ca.gov]; Grundler, Christopher[grundler.christopher@epa.gov]; Hengst, Benjamin[Hengst.Benjamin@epa.gov]; McCabe, Janet[McCabe.Janet@epa.gov]; JHamilton@ucsusa.org[JHamilton@ucsusa.org]; Lew, Shoshana (OST)[shoshana.lew@dot.gov]; Posten, Ryan (NHTSA)[ryan.posten@dot.gov]; Tamm, James (NHTSA)[james.tamm@dot.gov]
Cc: Aminah Zaghab[aminah@environmentamerica.org]; Ayala, Alberto@ARB[Alberto.Ayala@arb.ca.gov]; Bevan, Analisa@ARB[analisa.bevan@arb.ca.gov]; Corey, Richard@ARB[richard.corey@arb.ca.gov]; Eric Junga[ejunga@aceee.org]; Hebert, Annette@ARB[annette.hebert@arb.ca.gov]; Hilary Sinnamon[hilary@redmtngroup.com]; Jason Wynne[jwynne@pewtrusts.org]; Katz, Ken (NHTSA)[Ken.Katz@dot.gov]; Powell, Gregory (NHTSA)[gregory.powell@dot.gov]; rawn@ceres.org[rawn@ceres.org]; Ruben Aronin[ruben@betterworldgroup.com]; Shruti Vaidyanathan[SVaidyanathan@aceee.org]; Tonachel, Luke[Ltonachel@nrdc.org]; Yoon, Rebecca (NHTSA)[rebecca.yoon@dot.gov]; Zoe Lipman[zoel@bluegreenalliance.org]
From: Anderson, Blair (NHTSA)
Sent: Mon 5/23/2016 5:15:56 PM
Subject: RE: Meeting: TAR Mid-Term Evaluation

Having an issue with the call in number, please use:

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Sent with Good (www.good.com)

All times listed are in the following time zone:(UTC-05:00) Eastern Time (US & Canada)

From: Anderson, Blair (NHTSA)
Sent: Thursday, May 5, 2016 10:17:24 AM
To: Anderson, Blair (NHTSA); Janet McCabe (McCabe.Janet@epa.gov); Atkinson, Emily; JHamilton@ucsusa.org; carolina.zavala@arb.ca.gov; Christopher Grundler; Hengst, Benjamin; 'charmley.gov'; Lew, Shoshana (OST); Amerling, Kristin (OST); Posten, Ryan (NHTSA); Tamm, James (NHTSA)
Cc: Bevan, Analisa@ARB; Ayala, Alberto@ARB; Corey, Richard@ARB; Hebert, Annette@ARB; Tonachel, Luke; Aminah Zaghab; Jason Wynne; Zoe Lipman; Eric Junga; Hilary Sinnamon; Ruben Aronin; rawn@ceres.org; Shruti Vaidyanathan; Powell, Gregory (NHTSA); Yoon, Rebecca (NHTSA); Katz, Ken (NHTSA)
Subject: Meeting: TAR Mid-Term Evaluation
When: Monday, May 23, 2016 1:00 PM-2:00 PM.
Where: DOT HQ - W40-300 - 1200 New Jersey Avenue, SE, Washington, DC 20590

If you need to call into this meeting please use the call-in number below

Ex. 6 - Personal Privacy

Please be sure that all members of your group have their US Government Issued ID to clear security. Upon arrival please call 202-366-2775 and I will escort you to the conference room once your have cleared security.

Thank you

Heather Laca
Administrative Staff Assistant
Department Of Transportation
National Highway Traffic Safety Administration
1200 New Jersey Avenue, SE, W40-304
Washington, DC 20590
Office – 202-366-2775

From: Jonna Hamilton [mailto:JHamilton@ucsusa.org]
Sent: Wednesday, April 27, 2016 2:17 PM
To: mccabe.janet@epa.gov; mark.rosekind@dot.gov; Corey, Richard@ARB
Cc: Atkinson.emily@epa.gov; hengst.benjamin@epa.gov; yvonne.e.clarke@dot.gov; Ayala, Alberto@ARB
Subject: Meeting request

Dear Assistant Administrator McCabe, Administrator Rosekind, and Mr. Corey,
On behalf of the NGO communities that represent environmental organizations, consumer groups, national security groups, and business groups, I would like to request a meeting in May to discuss the mid-term evaluation and specifically the upcoming Technical Assessment Report (TAR) that is due out in June of this year. Our organizations would like to learn more about your approach to the mid-term evaluation process and the TAR and share our view on the mid-term evaluation as well as preview some additional analysis that we are working on.
We look forward to talking with you.
Thank you,
Jonna Hamilton

Jonna Hamilton
Senior Washington Representative
Clean Vehicles Program
Union of Concerned Scientists
1825 K Street NW, Suite 800
Washington, DC 20001
202-331-5451
JHamilton@ucsusa.org

To: Ayala, Alberto@ARB[Alberto.Ayala@arb.ca.gov]; McCabe, Janet[McCabe.Janet@epa.gov]; Atkinson, Emily[Atkinson.Emily@epa.gov]; JHamilton@ucsusa.org[JHamilton@ucsusa.org]; Zavala, Carolina@ARB[carolina.zavala@arb.ca.gov]; Grundler, Christopher[grundler.christopher@epa.gov]; Hengst, Benjamin[Hengst.Benjamin@epa.gov]; Charmley, William[charmley.william@epa.gov]; Solomon, Raquel@ARB[raquel.solomon@arb.ca.gov]; McCarthy, Mike@ARB[michael.mccarthy@arb.ca.gov]; Hebert, Annette@ARB[annette.hebert@arb.ca.gov]; Bevan, Analisa@ARB[analisa.bevan@arb.ca.gov]
From: Anderson, Blair (NHTSA)
Sent: Mon 5/23/2016 5:14:48 PM
Subject: RE: Meeting: TAR Mid-Term Evaluation

Having an issue with the call in number, please use:

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Sent with Good (www.good.com)

From: Ayala, Alberto@ARB <Alberto.Ayala@arb.ca.gov>
Sent: Monday, May 23, 2016 1:09:50 PM
To: Anderson, Blair (NHTSA); McCabe.Janet@epa.gov; Atkinson.Emily@epa.gov; JHamilton@ucsusa.org; Zavala, Carolina@ARB; grundler.christopher@epa.gov; Hengst.Benjamin@epa.gov; charmley.william@epa.gov; Solomon, Raquel@ARB; McCarthy, Mike@ARB; Hebert, Annette@ARB; Bevan, Analisa@ARB
Subject: RE: Meeting: TAR Mid-Term Evaluation

Hello,
Is this call still on? I am on the line.
-Alberto

Alberto Ayala, PhD, MSE
Deputy Executive Officer
CALIFORNIA AIR RESOURCES BOARD
1001 I Street, Sacramento, CA 95812
916.322.2892 (direct)
916.445.4383 (Exec. Office line)
Alberto.Ayala@arb.ca.gov

-----Original Appointment-----
From: heather.laca@dot.gov [mailto:heather.laca@dot.gov] **On Behalf Of** blair.anderson@dot.gov
Sent: Thursday, May 05, 2016 8:36 AM
To: blair.anderson@dot.gov; McCabe.Janet@epa.gov; Atkinson.Emily@epa.gov; JHamilton@ucsusa.org; Zavala, Carolina@ARB; grundler.christopher@epa.gov; Hengst.Benjamin@epa.gov; charmley.william@epa.gov; Ayala, Alberto@ARB; Solomon, Raquel@ARB; McCarthy, Mike@ARB; Corey, Richard@ARB; Hebert, Annette@ARB; Bevan, Analisa@ARB; Zavala, Carolina@ARB
Subject: Meeting: TAR Mid-Term Evaluation

When: Monday, May 23, 2016 1:00 PM-2:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: DOT HQ - W40-300 - 1200 New Jersey Avenue, SE, Washington, DC 20590

If you need to call into this meeting please use the call-in number below

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Thank you

Heather Laca
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Washington, DC 20590
Office – 202-366-2775

From: Jonna Hamilton [mailto:JHamilton@ucsusa.org]
Sent: Wednesday, April 27, 2016 2:17 PM
To: mccabe.janet@epa.gov; mark.rosekind@dot.gov; Corey, Richard@ARB
Cc: Atkinson.emily@epa.gov; hengst.benjamin@epa.gov; yvonne.e.clarke@dot.gov; Ayala, Alberto@ARB
Subject: Meeting request

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We look forward to talking with you.
Thank you,
Jonna Hamilton

Jonna Hamilton
Senior Washington Representative
Clean Vehicles Program
Union of Concerned Scientists
1825 K Street NW, Suite 800

Washington, DC 20001
202-331-5451
JHamilton@ucsusa.org

Cc: Lutsey NIc[nic@theicct.org]; Drew Kodjak[drew@theicct.org]
To: Charmley, William[charmley.william@epa.gov]
From: Peter Mock
Sent: Wed 1/27/2016 5:23:57 PM
Subject: Re: ICCT expert regarding the status of the EU light-duty vehicle 2020 and 2025 CO2 targets

Dear Bill,

The CO2 standards for 2020 were adopted end of 2014. The 95 g/km target for passenger cars applies for 2021, the 147 g/km target for light-commercial vehicles for 2020. The standards are based on vehicle weight. There are some provisions for EVs (called 'super-credits'). You can find a summary of the 2020/21 standards here:
http://theicct.org/eu-co2-standards-passenger-cars-and-lcvs

Keep in mind that all targets are based on the NEDC testing procedure. The real-world CO2 emissions are about 40% higher.
http://www.theicct.org/laboratory-road-2015-update
It is planned to introduce the WLTP in the EU from Sep 2017 onwards. With the introduction of the WLTP, the 2020/21 targets will be adjusted upwards to reflect that the WLTP is supposedly more realistic/stringent. The final NEDC/WLTP correlation procedure is not finalized yet but it looks like there might be a substantial weakening of the standards.

For the post-2020 CO2 standards, the preparations are ongoing. The Environment Committee of the European Parliament originally suggested a corridor of 68-78 g/km (based on NEDC). The European Commission has tasked the consultancy Ricardo-AEA to carry out an assessment of vehicle technology potential and costs. The study has been completed but is not published yet (a draft was presented at a stakeholder meeting in summer 2015). I tried to put the various cost curve studies into perspective in this blog:
http://theicct.org/blogs/staff/estimating-costs-vehicle-efficiency-lessons-experience
The Commission is now working on an Impact Assessment. It is expected that in spring 2016 there will be a "Communication", announcing that the Commission will come forward with a proposal for LDV CO2 standards (whether for 2025 or 2030 or both target years is uncertain at this point). The actual regulatory proposal is not expected until end-2016/early-2017.

ICCT is currently also working on out own post-2020 EU cost curve study. For this we have tasked FEV to carry out vehicle simulations and bottom-up cost estimates. FEV has delivered the draft final report to us in Nov 2015 and we are currently in discussion with them, hoping to receive a final report within the next weeks. In parallel we have started developing our own cost curves based on the FEV results as well as other sources.

I hope this information is useful for you. Please do not hesitate to follow-up with any questions you might have.

Best,

Peter

Dr. Peter Mock
Managing Director ICCT Europe
Neue Promenade 6, 10178 Berlin
+49 (30) 847129-102
peter@theicct.org

http://www.theicct.org
http://www.transportpolicy.net

http://eupocketbook.theicct.org

ICCT - International Council on Clean Transportation Europe gemeinnuetzige GmbH
Managing Director: Dr. Peter Mock, Amtsgericht Charlottenburg HRB 143557, VAT-IdNr. DE284186076

> On 26 Jan 2016, at 23:05, Drew Kodjak <drew@theicct.org> wrote:
>
> Hi Bill,
>
> We briefed Chris and Karl up on the compliance and enforcement status in Europe last week.
>
> Happy to do the same for you.
>
> In the interim, I'm copying Peter Mock, who can give you the current status of the CO2 standards post 2020.
>
> Warm regards,
>
> Drew
>
>
>
>
> On Jan 26, 2016, at 5:01 PM, Charmley, William <charmley.william@epa.gov> wrote:
>
> Dear Drew and Nic
>
>
> In the next few days I need to come up to speed regarding what is the status within Europe of the LDV CO2 standards.
>
>
> I know a few years ago they were discussing a 2020 target of 95 g/km, and then a goal of perhaps 65 g/km in 2025.
>
>
> Can you either point me to an ICCT document or blog, or let me know who I can talk to, to get the current lay of the land?
>
>
> Next week Chris, Karl Simon, Jim Blubaugh and I will be in Brussels and I would like do some home work in advance.
>
> Thanks
> Bill

To: Charmley, William[charmley.william@epa.gov]
From: John German
Sent: Sat 8/22/2015 4:52:56 PM
Subject: Re: ICCT response to NRC CAFE report

Bill,
Yes, my comments - 20 pages of single spaced text that I spent most of a week preparing - were largely ignored. Just a few corrections and clarifications around the edges.
And the peer review process is not public. The Committee is required to respond to all of the peer review comments in writing, but this is held within NAS/NRC and is not released.

I probably should demand that they remove my name from the list of peer reviewers, but I don't really want to go there.

And I am not on the engineering review board for NRC. They have a strong preference for PhDs.

John

On Aug 21, 2015, at 12:26 PM, "Charmley, William" <charmley.william@epa.gov> wrote:

John,

I was just reflecting back on this email sent in June in light of your Asilomar presentation comments on mass reduction.

It is disappointing if you provided comments on the report that were largely ignored. I thought you were on the engineering review board for NRC – seems like something the academy should do something about.

It is also too bad on the transparency part. For most reports that EPA has peer reviewed, we have to document the entire process, including the response to the peer review comments. It doesn't sound like that is part of the NAS/NRC process.

Thanks
Bill

From: John German [mailto:john@theicct.org]
Sent: Thursday, June 25, 2015 10:46 AM
To: Charmley, William
Cc: Olechiw, Michael; Nam, Ed; Alson, Jeff; Moran, Robin; Anup Bandivadekar; NIc Lutsey; Drew Kodjak; Joe Schultz
Subject: Re: ICCT response to NRC CAFE report

Thanks for the feedback, Bill! It is much appreciated.

I had a head start, as I was one of the peer reviewers for the report. Not that they paid much attention to my 20+ pages of comments - they ignored almost all of them in the final report.

Re Roland's charts. I have been resistant to even acknowledging the NRC 2011 report. This is because the report clearly states, in the summary and again in the introduction, that it constrained the applicability of its technology and cost data to the very near term, e.g.:

- "Tables S-1 and S-2 show the committee's estimates of fuel consumption benefits and costs for technologies that are commercially available and can be implemented within 5 years. The cost estimates represent estimates for the current (2009/2010) time period to about 5 years in the future." [NAS report page S-1]
- "Again,except where indicated otherwise, the cost estimates provided are based on current conditions and do not attempt to estimate economic conditions and hence predict prices 5, 10, or 15 years into the future." [NAS report page S6]
- "The cost estimates represent estimates for the current (2009/2010) time period to about 5 years in the future." [NAS report page 9-8]

The report is very clear that It's not applicable to 2025 and, thus, I don't think it should be quoted in that context.

Re costs from the 2002 NRC report. Your suggestion to use midsize car compliance is not straightforward, as this report was pre-footprint adjustment. Thus, there are no target values for a midsize car. The closest they came was a table showing the mpg and cost for a 14-year payback by vehicle class. The midsize car increased from a 1999 baseline of 27.1 mpg (26.2 after adding weight for future safety compliance) to 32.6 mpg (+20%) at a cost of $791 (midrange case). But 20% is only about half the increase from 1999 to 2016.

They did publish cost curves for cars and light trucks:

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Arlington, Virginia 22207
USA
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CAR LINES

ISSUE 2015 3 **JUNE 2015**

EUROPE

1. Ozone Pollution in Europe: Fewer Alert Days But Concentrations Still High

Air pollution by ground-level ozone continued to affect many countries across Europe during summer 2014, according to a new briefing published by the European Environment Agency (EEA). Almost all reporting countries exceeded the long-term objective set by EU legislation at least once, while the stricter alert threshold was exceeded only on four occasions.

Exposure to high concentrations of ground-level ozone can cause and aggravate cardiovascular and respiratory diseases. The European Union's Air Quality Directive sets four standards to reduce air pollution by ozone and its impacts on health:

- information threshold: 1-hour average ozone concentration of 180 µg/m3,
- alert threshold: 1-hour average ozone concentration of 240 µg/m3,
- long-term objective: the maximum daily 8-hour mean concentration of ozone should not exceed 120 µg/m3,
- target value: long-term objective should not be exceeded on more than 25 days per year, averaged over 3 years.

Concentrations of ground-level ozone significantly exceeded these standards during summer 2014, according to the EEA's latest analysis. However, the number of exceedances was lower than in many previous years, in line with the long-term downward trend observed over the last 25 years.

Depending on which threshold is exceeded, authorities in the affected areas and countries have to take specific measures. For example, exceeding the information threshold triggers an obligation to inform the population on possible risks, while exceeding the alert threshold requires authorities to take immediate action.

Key facts – summer ozone 2014

- Measurements were reported from 1607 monitoring stations across 30 European countries.
- Approximately 80% of these stations recorded at least one exceedance of the long-term objective between April to September 2014, with exceedances occurring in all reporting countries except Croatia, Estonia, Ireland, Romania and Serbia.
- Seven EU Member States (Austria, Cyprus, France, Germany, Hungary, Luxembourg, and Spain) had stations where ozone levels exceeded the long-term objective on more than 25 days. This corresponds to 6% of all reporting stations, affecting approximately 1% of the total population in the reporting countries.
- Averaged over the past three years, 16 countries (Austria, Bulgaria, Croatia, Cyprus, the Czech Republic, France, Germany, Hungary, Luxembourg, Poland, Portugal, Serbia, Slovakia, Slovenia, Spain and Switzerland) exceeded the 2012 target value.
- Ozone concentrations higher than the information threshold were reported from monitoring stations in 18 countries. No exceedances were reported by Andorra, Bulgaria, Croatia, Estonia, Finland, Ireland, Lichtenstein, Lithuania, Romania, Serbia, Slovenia and Sweden.
- Ozone concentrations higher than the alert threshold were reported only in France, on four occasions.

- Approximately 36% of the exceedances of the information threshold, 75% of exceedances of the alert threshold, and 20% of long-term objective exceedances took place during a single episode of high concentrations between 7 and 14 June 2014.

2. New Diesel Car Pollution Test Agreed

On May 18th, Member states agreed rules on assessing the real NOx emissions of diesel cars that could force manufacturers to comply with much stricter standards than currently in place. At present car emissions are assessed in laboratory tests that do not reflect real driving conditions, leading to results that are much better than the reality. New test rules, for both CO2 emissions and air pollution, are being negotiated by member state experts and the European Commission

Under the Euro 6 pollution standard agreed by member states and MEPs in 2007, all new cars should meet an 80mg/km NOx limit from this September. The recent decision on the new diesel pollution test was not opposed by any member state but Hungary, Slovakia and the UK reportedly abstained.

A number of controversial issues on the new tests must still be resolved. The policymakers have yet to decide how to translate the NOx limit into the new test. It is possible that they will introduce a multiplier that would effectively allow manufacturers to miss the target.

A decision must also be made in the next two months on when the new lab test, including for CO2, should come into force. A 2017 start date with a transition period to give the industry time to adapt is likely. Carmakers' lobby ACEA wants a "two-step date framework, which would allow industry the proper lead-time to apply the complex real driving emissions regulation and make very significant hardware changes to future vehicles".

Commission research published in 2013 showed lab techniques explained around a third of a recorded drop in average EU emissions from passenger cars of carbon dioxide (CO2), linked to reduced fuel consumption. ACEA said it was "actively contributing" to the development of the more stringent rules and was committed to introducing them as soon as it is feasible. "When considering all the issues that have to be addressed in finalizing the work, it becomes clear that unrealistic deadlines for implementing WLTP (real-world testing) simply cannot be rushed into," ACEA said.

The new testing method, the WLTP, was agreed by the United Nations Economic Commission for Europe (UNECE) last year. The Commission has been consulting on how to transition to the new testing method by 2017.

Research has shown that cars emit up to seven times more NOx on the road than in the existing laboratory test, said Greg Archer of NGO T&E. T&E is pushing for the new test to be implemented in such a way that the Euro 6 standard is strictly applied.

ACEA criticized the Commission's "piecemeal approach" in taking a final decision on the diesel test procedure without agreeing other implementation details. "This is not smart regulation. We need clarity in advance so that we can plan the development and design of vehicles in line with the new requirements," the association said.

ACEA is lobbying for a three year delay to new rules claiming they can make for their vehicles, according to an industry paper seen by the press. The European Commission wants to introduce the tougher standards by September 2017, but a position paper from the European car industry trade group says it "cannot envisage vehicle testing beginning before 1 January 2020". The paper from ACEA -- whose members include BMW, Volkswagen and Fiat Chrysler -- goes on to say a further year's delay might be needed because of the time required for all manufacturers to have newly-registered vehicles tested under the new rules.

Legislation introducing the new tests would need to be approved by both MEPs and member states.

Archer told a conference that that the gap between laboratory testing and real-world conditions is most pronounced in those countries with emissions-based vehicle taxation, such as the Netherlands.

The existing test procedure, used both for consumer labelling and for complying with EU car fleet average CO2 limits, allows manufacturers to test under conditions that do not emulate real-life driving conditions. Loopholes allow carmakers to overinflate tires, use special lubricants, remove wing mirrors and use unrealistic driving techniques to try and reduce fuel efficiency.

3. UK Motor Industry Counts Down To New Emission Regulations

The UK motor industry is counting down the final 100 days until new stricter European vehicle emissions regulations come into force in September, claiming that UK vehicle manufacturers are "ahead of the game" with more consumers already purchasing Euro 6 cars in increasing numbers. SMMT claims UK buyers have a "huge range" of Euro 6 cars to choose from

EU vehicle exhaust emission standards have been in place and gradually tightened since 1992, and from September 1 2015, all new cars registered will be required to meet Euro 6 exhaust emission standards for a number of air pollutants. And, ahead of the tightening of regulations, the Society of Motor Manufacturers and Traders (SMMT) said it was demonstrating its commitment to the new standards by showcasing the industry's latest Euro 6 cars on May 21st at its 'key' industry event SMMT Test Day.

According to SMMT's latest figures, with three months to go until September, around half of new car buyers already opted for Euro 6 cars last month – a number which has been increasing.

In April 2015, almost one out of every two new cars registered (45.9%) boasted Euro-6 technology, compared with fewer than one in five (18.7%) in September 2014. Meanwhile, 70.4% of the UK's top 10 best-sellers registered last month met the Euro 6 standard.

Mike Hawes, SMMT chief executive, said: "With 100 days still to go until the new Euro-6 standard becomes mandatory, new car buyers are shifting to these next-generation vehicles. This is the result of huge investment from manufacturers in clean technology – and the quicker we get these Euro-6 cars onto the roads, the quicker we'll see improvements in air quality."

SMMT said the latest Euro 6 technology vehicles emit "virtually zero" particulate matter, while nitrogen oxide emissions "are more than half those of previous generation motors built in the past five years". It also said the latest vehicles "boast the lowest CO2 emissions on record".

However, the EU currently regulates vehicle emissions through laboratory testing of exhausts rather than testing vehicles in real-world driving situations on the road. As a result, the EU plans were approved to introduce a real-world driving emissions test procedure, probably in 2017, as

European Commission said it was “well aware under real driving conditions, NOx emissions of diesel vehicles are significantly above regulated emission limits” (see above).

It follows SMMT’s ‘myth busting’ campaign launched earlier this year to challenge the “increasing demonization of diesel” vehicles, with campaigners often criticizing diesels for their impact on air quality.

4. MEP Calls for Ban on Diesel in Urban Areas

The European Commission should draw up a ‘transport and climate plan', including a ban on diesel in urban areas by 2020, an MEP drafting the European Parliament’s position on urban mobility has argued. The Commission should encourage member states to introduce such bans to cut harmful air pollution in cities and to gradually reduce the use of petrol cars in urban areas by 2030, with a view to taking them out of cities by 2050, Green MEP Karima Delli proposed.

For the EU to meet its greenhouse gas commitments, the targets must be followed by a shift away from fossil fuels in urban mobility, according to Ms. Delli. She wants EU and member state authorities to draw up electric mobility plans and set targets to double cycling rates in urban areas by 2025.

The European Commission will propose a plan on alternative fuels in 2017 as part of its energy union strategy. Commission Vice-President Maroš Šefčovič told MEPs that he is also planning to make the development of charging stations for electric vehicles a condition to receiving EU funding for road projects.

To make cycling and walking safer, Ms. Delli wants member states to introduce a new speed limit of 30 km/h by 2020 in cities.

Sustainable urban mobility “can help achieve the EU’s resource efficiency objectives, in particular those linked to the circular economy with its job-creating potential”, the MEP argued.

To help EU countries invest in infrastructure, she proposed to dedicate half of the revenues from the Eurovignette directive on road-charging for lorries to improve urban mobility and 75% of urban tolls to develop urban transport infrastructure. The Commission should set aside at least 20% of EU transport funding for sustainable urban mobility projects, she added.

MEPs in the transport committee have until 4 June to table their amendments to the draft position with a view to voting on it in July.

5. Air Pollution Costs European Region in Lost Production, WHO Says

Air pollution costs economies in and around Europe $1.6 trillion annually in diseases and deaths, or almost 10 percent of the region's 2013 gross domestic product, according to a World Health Organization study. The study of 53 nations in the European region was released by the WHO Regional Office for Europe and the Organization for Economic Cooperation and Development April 28 in Israel.

“Reducing air pollution has become a top political priority,” Christian Friis Bach, executive secretary of the United Nations Economic Commission for Europe, said in a statement.

The economic cost of deaths related to air pollution totals more than $1.4 trillion, with illnesses adding another 10 percent, according to the report. The $1.6 trillion total "corresponds to the amount societies are willing to pay to avoid these deaths and diseases with necessary interventions," the report said.

But it also said the estimated mortality in 2010 of 600,000 premature deaths linked to air pollution represented a "marked decrease" from 2005 for the region. The 53 countries in WHO's European region represent about a quarter of the world's countries and extend to Turkmenistan, Kazakhstan and Israel.

More than 90 percent of citizens in the region are exposed to outdoor fine particulate matter that exceeds WHO's air quality guidelines, the report said.

6. EU Climate Chief Sees Tough Talks on Carbon Market Reform, Car Targets

European Union lawmakers are set for difficult negotiations on a planned reform of the bloc's carbon market and a law to set emission limits for cars, EU Energy and Climate Commissioner Miguel Arias Canete said on May 28.

The European Commission, the 28-nation EU's regulatory arm, is drafting rules to implement a new target to cut greenhouse gases by 40 percent by 2030 from 1990 levels. The goal, which EU leaders endorsed last October, is tougher than the current objective to lower pollution by 20 percent by 2020.

"The two most difficult pieces of legislation we're going to deal with in the coming years is the review of the EU emissions trading system and the decarbonization of road transport," Arias Canete told reporters in Brussels May 28. "Those are the most complicated ones."

The EU headline climate target for the next decade translates into a 43 percent cut from 2005 levels for about 12,000 installations owned by utilities and manufacturers in the emissions trading system, or ETS. The pollution cap in the program will decrease 2.2 percent annually starting in 2021 compared with 1.74 percent in the eight years through 2020.

The commission intends to propose a draft law detailing how to implement the new goal on July 15, but can't rule out publishing it only after the summer break in August, according to a senior EU official. It could take EU governments and the European Parliament more than two years to agree on its final shape, said the official, who asked not to be identified, citing policy.

The most complex issues to be addressed in the draft law include the allocation of free carbon permits, according to Arias. Companies in the EU carbon market will buy most of the permits at government sales in the next decade, with allowances for auctions distributed among nations on the basis of verified emissions and gross domestic product criteria. Businesses prone to relocating production to regions without emission curbs will continue getting a bigger share of permits for free.

"We have two constraints: We have to maintain the proportion of allowances to member states, and we have a cap that decreases," Arias Canete said. One permit gives the right to emit one metric ton of carbon dioxide.

The commission could propose improved allocation of free allowances after 2020 to better target businesses at risk of carbon leakage and companies that can't transfer the cost of emissions to customers, the senior EU official said. It also is considering ways to coordinate various national practices of compensating companies for expenses relating to emissions passed on in electricity prices, or so-called indirect costs.

The planned law also could address the design of carbon-efficiency benchmarks, or standards used to determine the number of free permits, according to the official. While a periodic review of benchmarks may be considered, the annual updates that some groups seek have been deemed impossible.

Under the October deal on the 2030 framework, EU leaders asked the commission to examine measures for reducing emissions in transport. The regulator will host consultations with industry experts, government representatives and nongovernmental organizations on June 18th in Brussels. The EU, which already has binding emission targets for new car and van fleets, will propose new goals for the post-2020 period next year, Arias Canete said.

“We have to discuss the parameters and technological neutrality,” he said. “There is no pressure yet but it will come. This is no one size fits all.”

7. Spot Checks Show 94% Vessel Compliance with ECA Rules in European Waters

94 percent of spot checked vessels operating in European waters were found by the European Maritime Safety Agency (EMSA) to be compliant with new sulfur regulations for marine fuel, Ship Management International reports. A total of 1,458 vessels were checked between January and April of this year, with 6 percent of those, a total of 90 vessels, being found to be non-compliant.

The reasons for noncompliance were said to include keeping inaccurate records or having incorrect processes, being unable to produce satisfactory fuel samples, and having fuel in tank with a sulfur content above the permitted level of 0.10 percent.

As of January 2015, vessels operating within Emission Control Areas (ECAs) are required to burn fuel with a maximum sulfur content of 0.10 percent by weight, down from the previous limit of 1.0 percent.

The numbers compare to data released by the Port of Gothenburg in March, which showed 20 percent of ships were not complying with the new sulfur rules.

UK bunker supplier Geos Group says ship-owners and operators should be aware that the checks are taking place and ensure that their vessels meet the EU regulations. "It is increasingly important for fuel buyers to understand what they have on board in terms of specification, flashpoint and sulfur," Barry Newton, managing director, Geos Group said in an emailed statement. "Being in control of our supply chain from the oil refinery and onwards to the vessel means that our customers can trust us to supply top quality product every time."

The EU requires member states to conduct spot checks on a minimum of 10 percent of ships in its waters in 2015, although several states were said to be planning to exceed this and test up to 20 percent.

In February, the European Commission said that the number of Emission Control Area (ECA) non-compliance cases in Europe have been "very few" to date.

8. Rental Companies Welcome Agreement on 'Real World' Air Pollution Test

The European Union has come a step closer to introducing 'real world' air pollution tests for cars and vans after agreeing a more accurate procedure for measuring driving emissions. The BVRLA[1] has welcomed the agreement and looks forward to the new 'on the road' tests for NOx emissions being introduced in 2017 alongside a more accurate CO2 emission test cycle.

The new procedure agreed by EU regulators will require vehicles to be tested on the road and in traffic, rather than solely in laboratory-like conditions as is currently the case. This should provide more accurate, 'real world' NOx emission figures for diesel cars under the Euro 6 air quality standard.

The European Commission and member states still need to agree what the limits for the real world tests will be and whether they can be introduced by 2017. The Commission already has plans to bring in a new, more accurate CO2 test cycle in 2017 – the World Light Duty Test Procedure (WLTP).

"Air pollution is a major threat to public health so it is vital that we can accurately measure the part played by road transport, particularly diesel vehicles," said BVRLA Chief Executive, Gerry Keaney.

"This agreement is an important milestone in helping Europe get to grips with the issue of road transport based air pollution."

The BVRLA has already provided UK policymakers with a list of five measures they could take to help address road transport-based air pollution:

- Help regional authorities to use their newly devolved transport powers by providing a national framework for ultra-low emission zones
- Adopt the current tax regime to include NOx emissions, ensuring that any changes are well-signposted and non-retrospective
- Re-introduce 100% first-year allowances for companies renting or leasing ultra-low emission cars
- Provide better in-life incentives - for example freedom from tolls, congestion charges or parking fees – to encourage greater uptake of ultra-low emission vehicles
- Do more to support car clubs, car sharing and other alternatives to car ownership, and provide more low-emission public transport

9. EU Reports 4.5 Percent One-Year Drop in GHGs Covered by ETS

Greenhouse gas emissions from activities covered by the European Union's emissions trading system fell by 4.5 percent in 2014 compared with the previous year, the European Commission said on May 18th. The EU's executive arm said that data on emissions and the surrender by companies of carbon allowances to cover those emissions showed that in 2014, 1.8 billion metric tons of carbon dioxide-equivalent were emitted by the power stations, heavy industrial

[1] Established in 1967, the British Vehicle Rental and Leasing Association is the trade body for companies engaged in the leasing and rental of cars and commercial vehicles.

installations and airlines that participate in the ETS, representing about 45 percent of total EU greenhouse gas emissions.

This compared with emissions from ETS participants in 2013 of about 1.89 billion metric tons. In 2007, emissions were 2.01 billion metric tons, meaning emissions have declined by around 10 percent since then, even though the EU has added three member states: Bulgaria, Croatia and Romania.

Also since 2007, the ETS has extended its coverage to aviation emissions for flights between EU airports. However, these made up a small portion of overall emissions, totaling 59 million metric tons of CO_2-equivalent in 2014, the commission said.

EU Climate Action and Energy Commissioner Miguel Arias Cañete said the declining emissions showed that “economic growth and climate protection can go hand in hand,” and were “a powerful signal ahead of the new global climate deal to be agreed in Paris this December” that “carbon markets deliver cost-effective reductions.”

However, the commission said that the ETS carbon price continues to be affected by a surplus of about 2 billion allowances that built up because of past over-allocation of carbon permits to market participants, in particular when emissions dipped significantly because of economic recession in 2009. In July, the EU will finalize an ETS market stability reserve that will start to operate in 2019 and will remove some excess allowances from the system. In addition, the commission has said it will propose before August a reform of the ETS through 2030, by when the EU has pledged to cut its emissions by 40 percent compared to 1990 levels.

Commission Vice-President for Energy Union Maros Sefcovic said agreement on the ETS market stability reserve had been “very crucial” for commission plans to propose reforms to the system, and that ETS reform proposals would be published as part of a “summer package” that would also include measures to improve the functioning of EU electricity markets and to revise EU energy efficiency labeling rules.

10. MEP Proposes Weaker Machinery Pollution Rules

The MEP leading work on new air pollution limits for non-road mobile machinery has proposed weakening some standards, introducing new exemptions and granting extra time to comply. Elisabetta Gardini of the EPP group said she favored “more realistic and achievable emission standards” for NOx and particulate matter for certain sub-categories of engine.

Exemptions should be granted for 10-16 years for replacement engines in machinery already in service. Many engines complying with newer rules are too large to fit in existing machinery and allowing existing machines to go out of service would cause “major economic disruption” for users.

The Commission should be given the power to adopt technical laws on placing replacement engines on the market. Ms. Gardini wants to extend the transition period for implementing the new regulation to 24 months, from 18 proposed by the European Commission last year, to allow time for machinery to be redesigned to accommodate the larger engines. Manufacturers' associations have advocated such an extension.

A further extension of the transition period should be granted for engines used in mobile cranes as these are sold in relatively small quantities, Ms. Gardini said.

Small- and medium-sized businesses producing non-road engines should be given an extra 18 months to comply, rather than the extra 12 months proposed by the Commission. Ms. Gardini defined SME producers as those making fewer than 80 engines a year, rather than 50 as proposed by the Commission.

The railway sector in particular should be given extra time to comply and should be granted an exemption for projects already begun when the new regulation comes into force, because of long lead times in the sector, Ms. Gardini said.

The Commission proposal could also create an "excessive burden" for the inland waterways industry so the rapporteur advocates a "softer approach", particularly given the sector is "energy-efficient and environment-friendly".

MEPs on the European Parliament's environment committee will discuss Ms. Gardini's proposed changes on 4 June and have until 10 June to table their own amendments. The committee will vote on the matter on 15 July. Member states are still negotiating their position.

Non-road mobile machinery causes 15% of NOx emissions and 5% of particulate matter emissions in the EU.

11. Europe Calls for Tougher Limits on HFCs

The European Commission has called for a tougher U.N. Montreal Protocol to protect the ozone layer by curbing HFCs that have a global warming potential thousands of times greater than carbon dioxide. The European Union has already introduced its own law to curb climate-harming hydrofluorocarbons (HFCs), also called "F-gases", used in refrigerators and air conditioners.

Under an EU amendment to the protocol, proposed recently, industrialized countries as major users of HFCs, are asked to commit to an ambitious reduction schedule beginning in 2019 and ending in 2034.

Obligations for developing countries and economies in transition would be more flexible.

The European Union is seeking to lead the push for more ambitious action on curbing greenhouse gases ahead of a conference in Paris late this year to seek a new U.N. pact on tackling climate change. Miguel Arias Canete, European commissioner for climate and energy, called for a global HFC agreement without delay. "This would send an important signal ahead of the international climate negotiations in Paris later this year," he said.

After international action more than two decades ago led to the phasing out of ozone-depleting chlorofluorocarbons (CFCs), HFCs were introduced as industry-supported substitutes. But they trap up to 23,000 times more heat than carbon dioxide and can remain in the atmosphere for thousands of years.

Earlier this month, India made a surprise decision to phase-down the use of the highly potent gases. India, which had for years opposed action on HFCs under the protocol, proposed an amendment calling for a 15-year transition period for developing countries to phase down their use of HFCs.

David Doniger, a director at campaign group the Natural Resources Defense Council, noted there were a series of proposals on the table, from the United States, Canada and Mexico as well as

India and the European Union. "There proposals are different, but the differences are readily negotiable. There is a real chance to come to an HFC agreement as early as this fall," he said.

12. Ten Countries Breach Air Pollution Ceilings

Ten EU member states exceeded their air pollutant emission limits in 2013, down from 12 in 2012, according to preliminary data from the European Environment Agency. But total emissions of the four pollutants covered by the National Emissions Ceiling Directive (NECD) – NOx, non-methane volatile organic compounds (NMVOCs), SO2 and ammonia – were below EU-wide ceilings in 2013.

Overall emissions of NOx, volatile organic compounds (VOCs) and SO2 fell in 2013, compared with the previous year, but ammonia discharges rose slightly.

Six countries – Austria, Belgium, France, Germany, Ireland and Luxembourg – breached the NOx limits, down from nine in 2012.

Germany and France exceeded the NOx levels by the widest margin – 218 kilotons and 180kt respectively – while in percentage terms Luxembourg (41%) and Austria (32%) were the worst offenders.

Austria, Denmark, Finland, Germany, Netherlands and Spain have all failed to meet the ceiling for ammonia each year since the NECD limits were introduced in 2010, the EEA said. Germany had the highest breach in 2013 of 121kt, exceeding its limit by 22%.

VOC ceilings were breached in 2013 by Denmark, Germany and Ireland, down from four EU countries in 2012. In absolute terms, Germany again exceeded the limit by the greatest amount, 143kt, with Ireland the worst in percentage terms with 64%.

All member states complied with their SO2 limits for the fourth year in a row.

The EEA said road transport continued to be the main problem for NOx emissions, with reductions from the sector not as large as originally anticipated. "This is partly because the sector has grown more than expected, and partly owing to the increased penetration of diesel vehicles producing higher NOx emissions," the agency said.

Agriculture is the problem for ammonia emissions, accounting for almost 95% of total EU emissions. The EEA said that compared with other pollutants covered by the NECD, agriculture emissions have not decreased to the same extent since 1990.

The European Parliament is currently debating revised NECD limits for 2030, on the basis of which the European Commission will come forward with a new proposal after it scrapped plans by its predecessor.

13. EU Environment Ministers Want Flexible Air Pollution Targets

On June 15th, Environment ministers demanded flexibility in meeting EU air quality targets, after dropping a cap on methane emissions from draft pollution rules. Governments were split on whether the proposed reduction goals for 2030 should be legally binding or non-binding. Poland demanded the targets be pushed back to 2040 and Hungary said the bill should be scrapped, while others called for review clauses to be inserted in the legislation.

The revised National Emissions Ceiling Directive (NEC) puts controls on different types of air pollution in each member state. Its overarching goal is to cut the number of premature deaths caused by air pollution by half by 2030. 400,000 people die each year from air pollution in the EU, according to the European Environment Agency.

The United Kingdom, Lithuania, the Czech Republic and Hungary welcomed the removal of methane ceilings from the bill arguing that the cap overlapped with EU commitments to cut greenhouse gases.

Environment Commissioner Karmenu Vella said non-binding targets would be pointless. "This would essentially deprive the policy of its content," he said. He told ministers that they should keep the cap on methane. The proposed revision to the NEC Directive is the first time the European Commission has tried to limit methane emissions, 40% of which in the EU comes from agriculture.

But Vella added that the European Commission could back "clearly defined and tightly constrained provisions for flexibility".

The United Kingdom and France want flexibility until 2030 based on the United Nations Gothenburg Protocol. It would allow a target to be adjusted to take account of unforeseen circumstances. Under the European Commission's plans, flexibility based on Gothenburg is only allowed up to 2020. Belgium and Sweden signaled support for some limited flexibility.

The Czech Republic put forward a separate flexibility proposal. The plan, backed by Hungary, Poland, Estonia, and the Slovak Republic, would allow governments to make up emissions shortfalls in one gas, with surplus reductions in another. The focus of the Czech plan is on energy production. Should, for example, a planned nuclear plant not be built, the targets should be re-evaluated without the country being punished.

"Complete agreement [between member states] will never be possible, said Jan Kriz, Deputy Minister for the Environment. "That's why we tabled a proposal for more flexibility." "If member states prove they can cut emissions in other areas, they should be allowed to partially cut other targets," he said, before adding the targets should be binding to give certainty to investors.

"We think that the existing flexibility mechanisms set out in the Gothenburg protocol are sufficient," said Germany's Jochen Flasbarth, State Secretary at the Federal Ministry for the Environment. "We don't want any more wide-ranging measures," he said. We see the risk of this undermining current commitments".

Lithuania, Slovakia, Romania and Poland were among the governments demanding that the targets should be indicative and not-binding. Spain also said that the 2030 targets were too ambitious for the country to reach in time. Bulgaria said it expected funding to hit the targets.

Poland warned that that imposing additional environmental costs could cause a recession and said the deadline should be pushed back to 2040. Polish citizens would bear the highest compliance costs in the EU said Marcin Korolec, Poland's Secretary of State in its Ministry of the Environment. It was equivalent to €14.46 euros per capita per year, he said. The average cost across the EU ranged between €0 and €8 annually.

Hungary called for a completely new discussion on "an absolutely new basis". “We cannot accept the approach of the proposal," said Zsolt Németh, Hungary’s Secretary of State for Foreign Affairs. He said the reduction on methane and ammonia would hit agriculture in Hungary, where production is far behind the levels it was at in the 1980s under communism.

The meeting was a step towards member states agreeing a common position on the bill. Vella said that if a position could be agreed soon, negotiations with the European Parliament could begin in September.

The European Parliament is also considering the draft bill. Its Environment Committee is expected to vote on a report on the bill by Julie Girling (ECR), the lead MEP on it, ahead of a plenary vote expected in September. Reports indicate that the MEPs in charge of shepherding the bill through the committee – the shadow rapporteurs - have agreed that targets for 2025 should be binding, and that methane emissions should be included. If that position is backed by the whole Parliament, it will set up a fight with the Council over the bill.

But a “significant minority” of MEPs in the Environment Committee are against including methane. The Agriculture Committee also recently voted in favor of an opinion on dropping the ban.

After the vote of the full Parliament, talks with the Council of Ministers will begin. Both institutions must agree an identical text, before it can become law.

The demand for greater flexibility for national governments in meeting EU-set targets echoed the compromise reached by EU leaders last October on the 2030 climate and energy package. Heads of state and government agreed to reduce their greenhouse gas emissions by at least 40% compared to 1990 levels by 2030. They would increase energy efficiency and their share of renewables by at least 27% by 2030. But that EU-wide target would not be binding at national level, after some member states pushed to retain authority over their energy mix.

Green group EEB said that because methane contributes to ozone pollution, a contributor to respiratory disease, it should be regulated under the NEC Directive. EU climate policy does not require action on methane because countries can instead cut CO2 to meet their headline targets under the Effort Sharing Decision, said EEB’s Louise Duprez.

She called on lawmakers to retain the level of ambition in the proposal on ammonia. Reducing ammonia emissions would reduce particulate matter pollution, to which ammonia contributes, and ensure the agriculture sector is doing its fair share, she said.

14. Belgium and Bulgaria Taken to Court Over Poor Air Quality

EU regulators are referring Belgium and Bulgaria to the bloc's top court over the quality of their air, which poses a major risk to health, the European Commission said. It has also issued a final warning to Sweden that it needs to take action.

Commission data shows about 400,000 premature deaths per year linked to air pollution in the European Union, but member states have systematically missed targets to reduce levels of harmful emissions and particles associated with respiratory disease and some forms of cancer.

In its statement, the Commission said data showed Bulgaria had persistently failed to comply with legal limits on levels for PM_{10} produced by traffic and industry that can enter the lungs and bloodstream.

Belgium's track record has improved, the Commission said, but not sufficiently, with excessive levels of PM_{10} and nitrogen dioxide and sulfur dioxide. Sweden is also exceeding EU legal limits on pollutants and has been sent a warning, which if ignored could also lead to court action.

The European Court of Justice in Luxembourg has the power to impose daily fines if member states are found to be in breach of EU law.

Another nation previously singled out for failing to clean up its air is Britain, which has been given until the end of this year to submit new plans to the European Commission on how it will tackle levels of nitrogen dioxide.

EU legal limits for various harmful pollutants are less stringent than levels set by the World Health Organization. The new Commission, in office since late last year, initially proposed to withdraw proposals put forward by the previous executive on narrowing the gap between the different standards. It encountered angry resistance from some member states and many in the European Parliament, forcing the new air quality law back on to the agenda.

15. Germany to Mandate Construction Equipment Retrofits In High PM10 Areas

Germany has notified the European Commission of a draft ordinance mandating emission reduction requirements for diesel mobile equipment used at construction sites in areas that exceed the limit values for PM_{10}. Specifically, the ordinance would apply to the cities of Ludwigsburg, Markgröningen, Reutlingen, Stuttgart, and Tübingen in Baden-Württemberg.

The regulation covers diesel engines above 19 kW used in such equipment as mini-excavators, compaction machines or excavators. The requirements are based on the Non-Road Mobile Machinery Directive 97/68/EC, with an alternative to require retrofits with a PM emission reduction system (Partikelminderungssystem, PMS).

The following emission requirements, applicable to machines used in construction sites with four or more machines, will be phased-in between 2016 and 2019 (80% machines in 2016; 95% in 2018; 100% in 2019):

- Engine power ≥ 19 kW and < 37 kW:
  - From July 1, 2016: Stage III A or PMS retrofit
  - From January 1, 2019: Stage III A machinery have to be PMS retrofit
- Engine power ≥ 37 kW and < 56 kW:
  - From July 1, 2016: Stage III B or PMS retrofit
- Engine power ≥ 56 kW and < 560 kW:
  - From July 1, 2016: Stage III B or PMS retrofit
  - From January 1, 2017: Stage IV or PMS retrofit

From January 1, 2018, retrofit PMS will have to be approved according to the requirements of the second stage of the UN REC Regulation No. 132 for Class I systems (no increase in NO2 emissions). Until that date, retrofit devices can be approved as Class I or II, reduction stage 1 of the UN REC regulation. The approvals must be issued in accordance with one of the following protocols: (1) the Technical Rules for Hazardous Substances 554 (TRGS 554); (2) Verification of Emission Reduction Technologies (VERT); (3) quality seal of the Research Association for Diesel

Emission Control Technologies (FAD); or (4) Appendix XXVII of the Road Traffic Licensing Regulations (German designation: StVZO).

16. European Commission Launches Infringement Case against Germany's PKW-Maut

The European Commission has launched an infringement case against the German road charging scheme for cars, known as PKW-Maut. Germany adopted on 8 June 2015 a law introducing the PKW-Maut road charges for passenger cars. At the same time, it passed a law ensuring that vehicles registered in Germany benefit from a deduction of the road charge from the annual vehicle tax bill. This will lead—said the Commission—to a de facto exemption from the charge for cars registered in Germany, and only for those cars. Therefore, the charges could be described as a "toll for foreigners".

The Commission's main concerns are on indirect discrimination based on nationality. Two features lead to such discrimination. The first is the fact that, effectively, German users will not pay the road charge because their vehicle tax bill will be reduced by the exact amount of the charge. The second is that the price of short term vignettes, which are typically bought by foreign users, is disproportionally high.

Commissioner for Transport Violeta Bulc said: "A toll system can only be compliant with European law if it respects the fundamental Treaty principle of non-discrimination. We have serious doubts that this is the case in the final text of the relevant German laws. We are now acting swiftly to clarify these doubts through an infringement procedure in the interest of EU citizens."

17. EU And China Step Up Cooperation in Fight against Climate Change

The EU and China have agreed to step up their cooperation to fight climate change following the 17th EU-China Summit held in Brussels. In the EU-China Statement on Climate Change adopted by the Summit both sides commit to embark on low-carbon development and cooperate on developing a cost-effective low-carbon economy. The statement also highlights the importance of low-carbon investments and the need to increase ambition over time under the United Nations Framework Convention on Climate Change.

Miguel Arias Cañete, European Commissioner for Climate Action and Energy, applauded China's commitment to becoming a resource efficient and climate resilient, low-carbon economy. He said: "China and the EU are responsible for around a third of global greenhouse gas emissions. Add the United States, and we have around half of world emissions. Today's statement gives a strong signal that we are serious in the fight against climate change. We expect this to be reflected in an ambitious and binding global climate change agreement in Paris this December."

The EU and China agreed to intensify their bilateral climate cooperation for example in the areas of domestic mitigation policies, carbon markets, low-carbon cities, greenhouse gas emissions from the aviation and maritime industries, and hydrofluorocarbons (HFC). The on-going cooperation on emissions trading will be expanded, in view of China's plans to establish a nationwide emissions trading system by 2020.

18. EU Considering Future Action on Decarbonization of Road Transport

Road transport is responsible for around a quarter of the EU's final energy consumption and about a fifth of its CO_2 emissions. European Commissioners Arias Cañete, Bieńkowska and Violeta

Bulc, responsible respectively for Climate and Energy, Internal Market and Industry, and Transport, held a high-level conference in Brussels on June 18th to discuss the next EU-level actions on the decarbonization of road transport.

In the weeks preceding the conference, both the supporters and the opponents of tighter CO2 emission standards showed increased levels of lobbying activity. The Transport and Environment group (T&E) released an analysis concluding that Europe can only meet its future climate targets if it sets fuel efficiency standards for new cars, vans and lorries by 2025 or earlier. In a middle-of-the-road scenario where transport would reduce CO2 emissions by 30% by 2030, the study found that CO2 standards for all vehicles (cars, vans and lorries) in 2025 and 2030 would deliver as much as 42% of the emissions reduction required from transport.

Car makers and the European Automobile Manufacturers' Association (ACEA), on the other hand, have been reportedly lobbying the Commission to delay any new fuel efficiency standards for cars and vans until after 2030. ACEA presented a study by FTI Consulting on the potential effects of decarbonization on the competitiveness of the European automobile industry. According to the FTI study, the automotive sector faces higher reduction targets and is making bigger contributions to reduce CO2 than any other sector—by 2020 average emissions of new passenger cars will need to be reduced by 39% compared to their 2005 level.

The FTI analysis also emphasizes that future CO2 reductions are becoming more costly and less cost-effective. As vehicles become more fuel efficient, every additional percent in fuel consumption reduction is more costly, but brings less payback in fuel savings for the vehicle owner. The 2020 target will impose an additional €1,000-2,000 manufacturing cost per passenger car on the industry, estimates the study.

Meanwhile, four EU nations and European politicians from across the political divide called on the European Commission to publish next year a challenging 2025 emissions standard for new cars. In a letter dated June 16 to the European Commission, the environment or transport ministers from Finland, Ireland, the Netherlands and Sweden lent their support to publication in 2016 of "challenging new targets for 2025". They did not specify a level.

Separately a group of Green, center-right and liberal members of the European Parliament called on the Commission in a letter dated June 17 to confirm it would publish 2025 targets next year. Their letter pointed out the Commission had committed itself to assessing the range of 68-78 g/km.

The MEPs – including Karl-Heinz Florenz, and Peter Liese (EPP), Seb Dance and Matthias Groote (S&D), Catherine Bearder (ALDE) and Bas Eickhout (Greens) who sit in the European Parliament's environment committee – wrote to climate and energy commissioner Miguel Arias Cañete. "Following an evaluation of the success of the current targets for cars and vans for 2015 and 2020, it is crucial to assess what the most cost-effective targets for 2025 are," the MEPs wrote. The proposal should be published by the end of next year to allow industry enough lead time to meet the target, they added.

Carmakers exceeded a 2015 CO2 target for new cars two years early, while a 2017 target for vans was met four years in advance.

A Commission official said a review of post-2020 car and light commercial vehicle standards had already been announced for 2016-2017 and there would be extensive consultation involving all those affected.

Climate and Energy Commissioner Miguel Arias Canete said road transport, responsible for roughly 20 percent of EU carbon emissions, needed to play its part in achieving an EU pledge to cut emissions by at least 40 percent by 2030. Post-2020 standards would be "ambitious but achievable," he said.

Brussels does not intend to replace emission standards for cars and vans by including the sector in the emissions trading scheme (ETS) after 2020, the EU climate commissioner said. “I don’t think personally inclusion in the ETS can replace emission standards. It can be a complement but not a substitute,” he said, adding that member states are currently free to include transport in the ETS but that no country has done so.

The Commission will publish a strategy paper on decarbonizing transport in the first half of 2016, alongside a proposal to continue the Effort Sharing Decision setting emissions reduction targets in non-industrial sectors such as transport, buildings and agriculture after 2020, Mr. Cañete said.

Erik Jonnaert, secretary general of ACEA, said any future targets had to take into account a global perspective "to safeguard the competitiveness of the industry". He said the industry would only be "in a realistic position" to make any new commitments beyond 2020 once it had assessed the uptake of technologies such as electric and hybrid cars.

“With the Commission consultation on road transport emissions kicking off, and ahead of the COP21 conference in Paris, we have reached a pivotal moment in terms of road transport emissions policy,” stated Jonnaert. “We believe that we have an historic opportunity to develop a policy framework that will allow us to drive down road transport emissions whilst protecting jobs and growth. However, we need to recognize that there is no magic bullet or single solution. Rather, we need to adopt a comprehensive approach to tackling road transport emissions which draws on the full spectrum of solutions.”

This means not just focusing on continued emissions reduction from new vehicles, but also factoring in the elements that influence overall emissions from vehicles in use. These factors include the carbon content of fuels, driver behavior, infrastructure and the potential of intelligent transport systems (ITS).

To this end, ACEA is now working in partnership with over 50 relevant stakeholders – including businesses, trade associations, non-profit organizations, research bodies and think tanks – to examine the full potential of this approach for both light and heavy-duty vehicles. Policy makers should also focus on the most cost-effective measures, so as not to jeopardize the competitiveness of the European automobile industry.

Markus Heyn, member of the management board at Robert Bosch, which makes engines, told a Brussels conference that EU standards that led to the increase in fuel efficiency and lower emissions had helped make the European industry a world leader.

André Weidenhaupt from the ministry for sustainable development and infrastructure in Luxembourg – set to assume the EU presidency in July – called for more EU work on the electrification of transport.

Trucks received a lot of attention with some, including Mr. Zetsche, suggesting that market forces will drive fuel efficiency. Jos Dings of green group T&E said the US is already setting a second round of standards for trucks.

19. Several Carmakers Need To Improve CO2 Performance

Seven major carmakers will need to speed up progress towards 2020 EU emissions goals for new cars to avoid fines, according to analysis by campaign group T&E. Honda, Hyundai, General Motors and Fiat are the furthest off track, while Suzuki, BMW and Mazda are also struggling towards their targets, the NGO said.

Of 15 major producers it analyzed, only Honda, Suzuki and Hyundai have not yet met their interim CO2 targets for 2015.

The overall 2020 target for new cars of an average 95 grams CO2 per kilometer is likely to be met, T&E added. Overall new car emissions fell by 2.6% last year to beat the 2015 EU target early and by a significant margin, the European Environment Agency reported in April.

T&E estimates that the gap between real world emissions and those reported by carmakers based on laboratory tests continued to increase in 2014. It called on the European Commission to propose a new car CO2 target for 2025 based on real world testing next year, as part of planned proposals on climate policies for sectors outside the emissions trading system.

Peugeot-Citroën became Europe's lowest carbon carmaker in 2014, while Nissan made the biggest improvement in the performance of its new car fleet.

20. France Proposes National Clean Vehicle Scheme; Downgrades Diesels

Segolene Royal, the French Ecology Minister, announced a national clean air scheme designed to encourage cities beyond Paris to restrict circulation of older, more polluting vehicles, and to encourage purchases of electric vehicles. Under the plan, vehicles would be categorized (and color-coded) depending on their pollution levels.

The scheme follows the recently adopted Paris program that will restrict the circulation of older, high-polluting vehicles in the city. However, while the Paris program allows access for Euro 6 diesels, the national proposal excludes all diesels, including Euro 6 cars, from the most environmentally-friendly Category 1.

The plan was criticized by the auto industry. The European Automobile Manufacturer's Association (ACEA) has voiced its surprise and disappointment at the discrimination against Euro 6 diesel vehicles. "Policy should be technology-neutral to ensure the uptake of the latest low-emission vehicles. There is no reason to discriminate against clean diesel technologies," said ACEA Secretary General, Erik Jonnaert.

The new scheme will promote cleaner cars by granting them privileges such as free parking and access to priority lanes in urban areas from January 2016.

An optional sticker will rank cars according to their air pollutant emissions, ranging from blue for electric vehicles to grey for the oldest diesel and petrol vehicles. It ranks diesel cars below comparable petrol cars.

The new measure comes as part of the French government's plans to shift policy away from years of promoting diesel cars. "We have to give a message for moving beyond diesel - just as we are giving a message to move beyond petrol," said French Ecology Minister Ségolène Royal.

The ranking system will enter an experimental phase in September and come into full effect next year.

21. EU Set to Meet Green Energy Goal but UK, Netherlands Trail

The European Union is collectively on track to achieve its goal of sourcing a fifth of its energy from renewables by 2020, although Britain, the Netherlands and Luxembourg are lagging behind other states, the European Commission said. However it acknowledged that the transport sector - which accounts for around a quarter of greenhouse gas emissions - remained a problem area and was struggling to curb the use of fossil fuels.

EU officials are pushing renewables as they seek to reduce both carbon dioxide emissions and a dependency on expensive oil and gas imports, especially from Russia. Renewable energy is expected to have accounted for 15.3 percent of energy consumption in the EU last year, the Commission said, setting the bloc on course to reach its target in five years' time.

Its latest biennial progress report said 25 out of 28 nations should meet their 2013/2014 interim national goals. But, apart from the three laggards, it said France, Malta, Belgium and Spain may also need to ratchet up efforts, even though they have hit their interim targets.

Higher use of renewables such as wind, biomass, hydro and solar led almost half of the member states to reduce their gas consumption by at least 7 percent in 2013 and avoided around 388 million tons of carbon dioxide emissions, the report said.

Following on from the 20 percent goal for green energy for 2020, the EU has an outline target to increase the share of renewables to at least 27 percent by 2030. But some environmental campaigners and green politicians said the Commission was in danger of complacency and that the 2030 goal was not ambitious enough. "A whole new impetus is necessary to boost renewables in Europe and worldwide," said Claude Turmes, Luxembourg Green Member of the European Parliament.

For green energy in transport, the 2020 target is 10 percent, while the expected level for 2014 was 5.7 percent. No target has been set for 2030. The Commission said meeting the 10 percent target "is challenging but remains feasible".

A major problem has been policy uncertainty due to concerns many kinds of biofuel could be damaging to the environment. Apart from driving up food prices, using farmland to produce biofuels adds to pressure to free up land through deforestation, which can result in increased greenhouse gas emissions. To address the problem, in April EU politicians backed a deal to limit the amount of crop-based biofuel that can be used in the transport sector.

22. New Large Plant Pollution Standards under Fire

The EU has provisionally agreed new environmental standards for large combustion plants that industry says will be tough to implement but NGOs say are too weak to reduce the enormous public health impact of air pollution.

Member state negotiators agreed a revised best available technique reference document (BREF) for plants such as large coal-burning power stations at a meeting in Seville, Spain. The new standards, implemented through operating permits, are likely to come into force in 2020 or 2021, depending on when the European Commission publishes the Seville decision.

The standards adopted will lead to reduced NOx and SO2 emissions compared to the status quo. But they offer little improvement on the existing standards, dating from 2006, on many counts and do not reflect genuine best available pollution levels, said green group EEB's Christian Schaible, who was at the talks.

EEB has argued that 71,000 additional deaths and €52bn of lost working days are likely over 2020-29 as a result of weak standards rather than what it sees as genuinely possible using best available techniques. Mr. Schaible said he believes this assessment remains accurate because the ambition level has not significantly improved during the negotiation of the new standards.

As warned by Greenpeace in March, the standards adopted for NOx pollution are weaker than those in place in China and the US.

The upper emission range agreed for mercury is weaker than the US standard and is likely to only require additional abatement by the most polluting plants, those burning lignite, Mr. Schaible said. The current BREF does not set specific abatement requirements for mercury.

A derogation has been introduced for large coal plants burning low-quality indigenous fuel with a high sulfur content, although the rules for these plants are more stringent than under an earlier draft. This measure was pushed by the Czech Republic, supported by other countries including Poland and Bulgaria that are concerned about the economic cost of having to upgrade their coal plants.

Power producers association Eurelectric said the economic impact of the revised BREF had been "totally ignored" in the negotiations, including the impact on security of supply. "We are convinced the European Commission should conduct a thorough impact assessment," a spokeswoman said. "Between 1990 and 2012, the electricity sector has already decreased its emissions of SO2 and NOx by 85% and 55% respectively, while emissions of [particulate matter] were reduced by 70%," she said, adding that power production rose 30% over this period.

The BREF strengthens the standards for new coal plants, but none are expected to be built meaning this is unlikely to have a major impact. Tighter requirements are also introduced for peat-fired plants, in spite of opposition from Finland and Ireland which use this fuel.

Greece and France successfully lobbied for weaker SO2 and dust limits for plants on islands burning highly polluting fuel oil than was originally proposed by the Commission.

EEB called on the Commission to adopt and publish the decision without delay to allow the revised BREF to enter force as soon as possible.

23. Roads Still Transport 75% of EU Freight Failing To Shift More to Rail, Marine

Three-quarters of inland freight has been transported on roads since 2008 despite efforts to switch to less polluting modes, according to the latest Eurostat figures. The share of rail was around 18.2% in 2013, slightly below the shares of the previous two years but showing a general increase compared to the 16.9% share in 2009 when the rail sector experienced a "noticeable drop", Eurostat said.

The volumes transported along inland waterways have stayed above 6% since 2008, reaching 6.9% in 2013.

The European Commission is currently reviewing its 2020 transport strategy, which experts agree has failed to shift transport from road to rail and ships.

The Eurostat figures, measured in ton-kilometers, show large variations in the modal split among EU member states. Road transport increased its share by more than 5 percentage points in Poland, Lithuania, Bulgaria and Luxembourg over 2008-13. By contrast, the share of road transport dropped by 12.1 percentage points in Romania in favor of inland waterway transport. Drops of more than 5 percentage points were also recorded in Hungary and Slovenia primarily due to an increase in rail transport.

Only 17 member states have navigable inland waterways. In the Baltic States rail has historically had a share in the range of 70-80%, largely due to the transport of Russian energy products to the countries' ports, but the share fell in Estonia and Lithuania in 2013.

24. London's Famous Double-Deckers Might Be Banned On Smoke-Choked Oxford Street.

Taking the bus instead of driving your car is usually a smart way to do your part to reduce toxic vehicle emissions while helping your city reduce traffic jams. But in one of the busiest shopping districts in the world, London's Oxford Street, buses have long been identified as a significant part of the area's air pollution problem. Now officials in the U.K. capital are considering kicking the iconic red double-deckers off the road.

Peter Hendy, the commissioner of Transport for London, announced this week that the agency is considering removing buses from the bustling retail street. "For years we've been accused of being dog in the manger about buses on Oxford Street, now we are in a completely different place," Hendy told the London Evening Standard. "We are looking at all the options and we will countenance taking all the buses out. We wouldn't rule anything out."

It's a move that is sure to cheer Oxford Street business owners, air quality advocates, and tourism promoters, who have long pressured officials to reduce the number of pollution-generating vehicles on the road. According to the Standard, an astounding 270 buses roll up and down Oxford Street every hour, shuttling some of London's 8.62 million residents, as well as millions of tourists (London was the world's top tourism destination in 2014). The road is also a "street canyon"—the buildings that line Oxford Street rise high along the narrow thoroughfare, trapping toxic gases between them.

Last year researchers at King's College London set up an air pollution monitoring station on the shopping strip. The scientists found a peak level of nitrogen dioxide of 463 micrograms per cubic meter coming out of diesel-fueled tailpipes and other sources—more than 10 times the European Union's safe limit of 40 micrograms per cubic meter. That gave Oxford Street the dubious distinction of having the dirtiest air of any urban thoroughfare in the world. Although London's mayor, Boris Johnson, initially disputed those findings, last fall he admitted that air pollution along Oxford Street was out of control.

Toxic particulate matter from vehicles is to blame for an estimated 60,000 deaths per year in Britain, according to the U.K.'s Committee on the Medical Effects of Air Pollutants, and Londoners are disproportionately affected. But residents—or tourists heading to Selfridges or to Topshop's flagship store on Oxford Street—aren't the only ones being sickened by heart- and lung-disease-causing exhaust fumes. Worldwide, about 7 million people die every year thanks to poor air quality, according to the World Health Organization.

Various emissions-reducing solutions, such as encouraging Londoners to cycle to work using underground bike lanes, have been proposed to cut the city's overall air pollution. Given that the EU Supreme Court ruled in April that the U.K. has to reduce emissions or pay hundreds of millions of pounds in fines, it seems that the government has no choice but to clean up its act.

25. European Big Oil and US Counterparts Not Aligned On Climate Change Policy

The heads of Europe's largest oil and gas companies joined together for the first time to call for governments to agree on carbon pricing at a United Nations climate summit, opening a schism with their American rivals. "It's clear that the subject isn't viewed in the same way on both sides of the Atlantic," Total SA Chief Executive Officer Patrick Pouyanne, one of the signatories, said on June 1 at a press conference in Paris. "We are working with those who come forward."

The banding together on climate change policy by BP Plc, Eni SpA, Royal Dutch Shell Plc, Statoil ASA, Total and BG Group Plc is unprecedented and follows comments by some of their chief executive officers calling for the industry to be part of the debate on a deal limiting greenhouse gases. It also highlights division within the sector as the top American companies, Exxon Mobil Corp. and Chevron Corp., decided to stay out of the European initiative.

"Climate change is a critical challenge for our world," the heads of six European energy companies wrote to the top UN official in charge of climate talks. "We need governments across the world to provide us with clear, stable, long-term ambitious policy frameworks."

Pouyanne pointed to remarks made in late May by a U.S. oil executive, whom he didn't name, that illustrated the difference in approach between companies on opposite sides of the Atlantic. Exxon Mobil CEO Rex Tillerson said he didn't intend to "fake it" on climate change. The company said on May 27 that it supports a carbon tax over a cap-and-trade system. Exxon is "actively engaged" with the European companies through the International Petroleum Industry Environmental Conservation Association, or IPIECA, representing more than 60 percent of oil and gas production, spokesman Scott Silvestri said.

Chevron CEO John Watson said the company wouldn't join the European initiative. "We think we can make our statements, and our statements speak for themselves," he told shareholders in May. The company said June 1 that it has been engaged on the topic of climate change and, like Exxon, pointed to its membership in IPIECA. "We believe that taking prudent, practical and cost effective action to address climate change risks is the right thing to do," Chevron said in a statement.

Nonetheless, the split resembles another industry schism in 1997–1998, when BP and Shell broke ranks with their American oil counterparts leaving the Global Climate Coalition, at that point the U.S. industry's foremost lobbying group in fighting efforts to limit the use of fossil fuels.

The letter to Christiana Figueres, the executive secretary of the UN climate body, and Laurent Fabius, the French foreign minister, promotes natural gas as the least-polluting of fossil fuels, in opposition to coal, and coincides with the start of the World Gas Conference in Paris the week of June 1. "We write to highlight the major role natural gas can play in addressing climate change," the CEOs said in a separate letter published in the Financial Times.

The main lobby group for the coal industry responded immediately, saying that for "many countries, the reality is that the only way they can meet their growing energy needs is through affordable, readily available coal." In its statement, the World Coal Association said "cleaner coal technologies" were vital to reduce carbon emissions.

The push by Europe's oil companies comes as efforts to reduce fossil-fuel investments and spur renewables such as solar have gathered pace in the past two years, with oil companies sitting largely outside the debate. The European firms are more sensitive to environmental issues because governments in the region are leading the way on climate and voters are demanding action.

Carbon pricing was the main theme of a May meeting—also in Paris—of business leaders on climate change when CEOs from the banking, insurance and consumer products industries, as well as energy, called for a cost to be placed on carbon emissions as an incentive for companies.

Negotiators began 11 days of meetings in Bonn June 1 to work out differences ahead of talks in Paris later this year. The goal of envoys from more than 190 nations is a deal that for the first time would require developed and developing countries to take action.

Despite the public split between U.S. and European energy groups, emissions data released through the Carbon Disclosure Project show little difference between both sides. All have reduced pollution "slightly" since 2011, with BP in the lead mainly because of asset sales needed to pay $40 billion in costs associated with the Gulf of Mexico disaster in 2010.

The letter could provide the European oil groups with alternative arguments to counter the divestment campaign, which has persuaded institutions such as the Rockefeller Brothers Fund and Stanford University to scrap fossil fuel investments. French insurer Axa SA and Norway's sovereign wealth fund, two of the world's most influential institutional investors, also announced that they will reduce their investments in coal mining and coal power plants.

The coming together of the European companies was borne out of an encounter by BP, Shell, Statoil and Total executives in Oslo, Pouyanne said June 1. "We realized that we were fundamentally in agreement," he said. "Because we make up a significant part of the oil major market, it would be worth it that European oil companies make a commitment without necessarily having an American oil company on board." Discussions with U.S. oil companies have taken place and "we hope that one of them will join us soon."

A predecessor also without American participation called the Oil and Gas Climate Initiative was started in January 2014 and includes Total, BG and Eni, as well as Saudi Aramco, Petroleos Mexicanos and China Petroleum & Chemical Corp. It focuses on gas flaring, methane emissions, carbon capture and storage.

26. Carbon Permits Glut Limits Germany's Options to Meet 2020 Reduction Target

A glut of European Union carbon-emission permits is limiting Germany's options to meet its 2020 greenhouse gas reduction target, according to the nation's environment ministry. Europe will take years to eliminate its surplus before cost-effective climate strategies based on carbon markets will get traction, Dirk Weinreich, head of climate policy in the ministry, said on June 15th. Germany wants to cut emissions at home to meet its most immediate climate goal rather than just buy and retire pollution allowances, he said.

Europe's carbon-permit glut led to a 74 percent slump in the cost of emissions since 2008, eroding the penalty for burning coal and prompting market reforms that probably won't start for more than three years. Forcing utilities in Germany, primarily RWE AG and Vattenfall AB, to switch to cleaner natural gas from coal would cost about six times the current carbon price, according to consultants Bain & Co.

“We still live in the world of surpluses” and canceling allowances “would not change anything,” Weinreich said. The carbon market is “like the machine room in a big ship. It gives the basic drive. If you want to change direction quickly you may need additional engines at the sides.”

Germany is targeting a 40 percent reduction in emissions by the end of the decade from 1990 levels. European Union lawmakers plan to control the supply of carbon permits through a market reserve that will start in 2019. The reserve start is probably too late for Germany, which is considering alternatives to fill the probable 7 percent gap in its 2020 target because coal emissions are still too high, Weinreich said. “We are talking about additional instruments as a transition,” he said, without being specific.

Chancellor Angela Merkel's cabinet has targeted lignite plants—power-generation's biggest polluters that account for a quarter of electricity output—to take the brunt of additional emission cuts through 2020.

Forcing coal plants to shut would push up power prices by about 10 percent as more natural gas generators would be used to cover demand peaks, according to UBS Group AG.

Closing stations to reduce emissions equates to a cost of about 50 euros ($56) a metric ton of carbon dioxide, according to Boston-based Bain, which advises companies in industries from airlines and health care to energy. That compares with 7.52 euros to buy a benchmark EU permit to emit one ton of carbon dioxide, data from ICE Futures Europe in London show.

Industry and other energy consumers are seeking cheaper emission-reduction policies, according to Julian Critchlow, a partner at Bain. “Policy makers must embrace lower-cost pathways. That's the lesson from Europe writ large,” Critchlow said.

Germany can show climate negotiators seeking a global treaty in Paris this year that reducing carbon at the cheapest price is sensible, no matter where the emissions are located, he said, adding that it also leaves money on the table for additional climate measures.

“The cost effectiveness, not only from a national perspective but from a global perspective, will be key,” Fatih Birol, the chief economist at the International Energy Agency, said in a June 15 interview in London. It could be easier for some countries to reduce emissions elsewhere than at home, he said.

Emerging nations want to be shown how to cut their emissions, Germany's Weinreich said. Merkel is seeking a global carbon market to help finance clean energy in poorer nations and win their support for a climate deal, she said.

“We have set the precondition to reach a more cost-effective European, and maybe German, policy on climate,” Weinreich said. “If we have a functioning emissions-trading system, maybe the need for other measures is a bit lower.”

NORTH AMERICA

27. California Cities Still Have Nation's Worst Smog, Report Shows

Despite years of progress, California cities have the worst smog and particulate air pollution in the nation, conditions made worse by the state's ongoing drought, a report shows. The annual report by the American Lung Association comes as the state struggles to protect both water and air in the face of a prolonged, catastrophic drought that is entering its fourth year.

"Residents exposed to air pollution are at greater risk for lung cancer, asthma attacks, heart attacks and premature deaths," said Olivia Gertz, president of the American Lung Association in California.

Five California cities, including Los Angeles, Bakersfield and the state capital of Sacramento, led the nation in ozone pollution, commonly called smog, during the two-year period from 2011 to 2013, according to the report. The worst cities for both seasonal and annual particle pollution - the soot and dust made worse by warm, dry conditions during the drought - were also in California, the report said.

More than 70 percent of California residents, about 28 million people, are exposed to unhealthy air during the year, the report said.

According to the report, the Los Angeles area led the nation in smog, while the Fresno-Madera area in the state's San Joaquin Valley breadbasket had the worst particulate pollution.

Nationwide, metropolitan areas with the worst smog included Los Angeles, Visalia, Bakersfield, Fresno and Sacramento in California, followed by Houston; Dallas-Ft. Worth; Modesto, California; Las Vegas and Phoenix, the report showed.

Despite the rankings, the report showed that overall California's air has improved since the organization began tracking pollutants in 2000.

The number of bad air days in the San Francisco Bay Area and San Diego, for example, dropped 80 percent between 2000 and 2013. Particle pollution also fell during the period, dropping 70 percent or more in the Los Angeles, San Francisco, Sacramento and San Diego areas.

As the drought has continued, pollution levels ticked up in the state. The conditions have made it more difficult to keep the air clear in the state's vast valleys, where geography and warm, dry weather combine to keep dirt, haze and pollutants close to the ground.

In the summer of 2014, California was out of compliance with federal ozone rules for 99 days in the San Joaquin Valley, up from 89 the year before. Sooty particulates, which cause brown haze in the late fall and winter, were up throughout the state last winter.

28. Air Resources Board Releases Concept Paper on Short-Lived Climate Pollutants

The Air Resources Board has released a concept paper[2] describing ways in which California can move forward aggressively to reduce greenhouse gas and smog-causing emissions from a group

[2] The Short-Lived Climate Pollutants Concept Paper can be found at: www.arb.ca.gov/cc/shortlived/shortlived.htm

of chemicals with extremely high global warming potential. These chemicals may be responsible for as much as 40 percent of the global warming to date.

Short-lived climate pollutants (SLCPs) include methane, black carbon and fluorinated gases (refrigerants, insulating foam and aerosol propellants). These gases trap heat at many times the level of carbon dioxide, but also tend to have a shorter duration in the atmosphere than carbon dioxide, making their most dramatic climate impact over a period of days to about 10 years.

“Reducing the emissions of these short-lived climate gases is an important part of California’s – and the world’s – efforts to keep the planet from exceeding the most dangerous levels of warming,” said ARB Chairman Mary D. Nichols. “Taking steps to significantly reduce these greenhouse gases now will deliver climate and air quality benefits in the short-term while we move our energy systems and vehicle fleets to clean technologies.”

Strong planning and decisive actions on these climate pollutants will deliver reductions over the short-term and will play an important role in achieving the Governor’s goal of reducing greenhouse gases 40 percent by 2030. The concept paper identifies scientific targets that align with levels of reductions needed worldwide to stabilize the climate, including reducing methane emissions by at least 40 percent.

Senate Bill 605 requires ARB to develop, in coordination with other state agencies and local air districts, a comprehensive strategy to reduce emissions of short-lived climate pollutants. The release of the concept paper marks the first step in developing that strategy. A public workshop was held on May 27 to discuss the concept paper and overall strategy development.

Working on a fast-track, ARB will develop an initial draft strategy through public workshops over the summer. The draft proposed strategy will be presented to the Board in the fall and will include specific actions over a broad array of economic sectors, including the natural environment and biological systems.

Action to reduce emissions of these gases can also improve air quality and reduce related health risks, hospitalizations and medical expenses, especially in disadvantaged communities. Other benefits to California include reducing damage to forests and crops, reducing background ozone and particulate levels to help meet federal air quality standards, and reducing disruption of historic rainfall patterns.

For black carbon, produced in California primarily from diesel combustion and burning wood (including wildfires), the concept paper suggests building on, accelerating and expanding existing programs including the ongoing sustainable freight strategy and forest management.

Development of a regulation by ARB is already underway to reduce methane emissions from oil and gas drilling and storage sites. The concept paper addresses the need to act on other sources, including reducing methane emissions from dairies and eliminating the disposal of organic materials at landfills. The concept paper suggests an approach to consider new funding mechanisms and a range of incentive structures to address all sources.

“Reducing methane and other short-lived climate pollutants is an increasingly essential part of achieving California’s goals of reducing the impacts of climate change; protecting our land, air, water and communities; and enabling California’s farming sector to thrive,” said Sustainable Conservation Executive Director Ashley Boren. “Sustainable Conservation looks forward to working with state agencies, our agricultural partners and other stakeholders in developing effective strategies and incentives that work for farmers, agricultural communities and the environment – and putting the state on the path to meeting its climate change and air quality goals."

As for so-called fluorinated gases, the paper looks to an 80 percent reduction by 2030 in the use of hydrofluorocarbons (HFCs) in new refrigeration and air conditioning equipment, and taking early actions to significantly reduce these gases from commercial refrigeration. There is already an ARB program in place to address leaks from commercial systems.

Development of this plan will align with efforts being made by Mexico, one of the State's international partners in efforts to curb the impacts of climate change and fight air pollution. Mexico is the only country to specifically include SLCP emissions in its reduction pledge for the upcoming Paris climate summit. Under an agreement signed last year, California and Mexico are working together on a host of climate and air quality issues, including short-lived climate pollutants. Last December, California and Mexico co-hosted an event on short-lived climate pollutants at the international climate meetings in Lima, Peru.

California already has some of the most stringent and effective regulations in the country for methane and black carbon. Our efforts to control emissions from diesel vehicles have reduced black carbon 90 percent since the 1960s, while diesel consumption has since tripled. These reductions help avoid about 5,000 premature deaths each year in the state, and if similar black carbon reduction levels were achieved globally, studies show it would avoid millions of premature deaths annually and slow the rate of global warming by about 15 percent.

29. California ARB Releases DPF Evaluation Report

On 15 May, the California Air Resources Boards (ARB) released a report that discusses their findings regarding the cost, reliability, and fire safety of diesel particulate filters (DPF) in on-road applications.

The ARB evaluation concluded that (1) PM filters do not increase the likelihood of truck fires and are manufactured in accordance with federal and state safety requirements; (2) PM filters are effective in removing more than 98% of toxic diesel PM emissions; and (3) PM filters are operating properly, and most trucking fleets are not having problems with their engines or PM filters. While some fleets are experiencing problems with their PM filters, engine durability issues and inadequate maintenance practices are the primary reasons for these problems, found the report.

Some of the key findings of the report include:

- The ARB evaluation indicates that DPFs do not increase the risk of truck or bus fires. National vehicle fire statistics suggest the frequency of truck fires is decreasing over time. Before the widespread deployment of PM filters, between 2004 and 2006, heavy-duty trucks accounted for 16,300 truck fires nationwide. Between 2008 and 2010, when virtually all new heavy-duty trucks were equipped with PM filters, heavy-duty trucks accounted for 13,200 truck fires. These data show that over this period truck fires declined by 20%. Over the same period, national diesel fuel sales, which are a reliable indicator of the amount of miles driven by trucks, declined by 6%. These data indicate during this period that heavy-duty truck fires declined at a greater rate than fuel sales, which suggests heavy-duty truck fires may be declining over time.

- The ARB has identified three fires, which occurred between 2011 and 2012, involving two models of previously verified retrofit DPFs. In all cases, the filters in question were constructed with metal rather than ceramic filter cores, were impacted by engine component malfunctions, and, in addition, were not operated properly. Shortly after the fires, ARB took prompt action to address potential future issues associated with improper operation of these verified retrofit PM filters.

- Some truck owners are experiencing vehicle downtime due to mechanical failures of their engines. The ARB believes that this downtime is caused by engine component failures, such as a turbocharger or EGR device, that cause the engine to generate excessive PM at rates that exceed designed values for PM filters. Many engine component failures are initially and incorrectly diagnosed as PM filter issues. Continued operation of a vehicle with malfunctioning or failed engine components and/or triggered malfunction indicator lights can damage the core of the PM filter if not addressed promptly. A small fraction of trucks with damaged PM filters appears responsible for the majority of PM emissions from the filter-equipped fleet.

- The analysis of warranty claims data indicates that MY 2010 and newer engines have better durability performance—as measured by warrantable claims for engine component failures—than engines manufactured between 2003 and 2009. Preliminary warranty reports from MY 2012 engines suggest better performance than the MY 2011 engines. Additionally, MY 2013 and newer engines are equipped with standardized onboard diagnostics that should encourage improved engine durability.

- A close examination of the warranty claims suggests upstream engine components could be the root cause of PM filter problems. Virtually all engine families with reported claims for the PM filter also had reported claims for another engine-related component. A total of 208 heavy-duty diesel engine families were sold between MY 2007 and 2011; of these, 127 engine families reported warranty claims for an upstream engine component, of which 77 had claims reported for an emissions-related component and the PM filter, where 44 engine families reported claims for an emission-related component and not the PM filter, and only six reported claims for the PM filter alone.

The report includes five recommendations in regards to future ARB efforts:

- Continue Working to Hold Manufacturers Accountable. New in-use emission measurement programs will help better enforce engine certification standards. Additionally, the ARB is considering amendments to their Emissions Warranty Information Reporting regulations to hold manufacturers accountable for high warranty claims that can result in excess emissions.
- Educate Truck and Bus Owners and Operators. The ARB will identify best preventive maintenance practices to maintain properly functioning engines, and to disseminate this information to fleets.
- Enhance Certification Programs. Improvements to ARB's certification program requirements will provide broader in-use protections, greater warranty protections, and better assurances of engine component durability.
- Develop Stronger Inspection and Maintenance (I/M) Requirements. ARB is developing a proposal to expand heavy-duty truck inspection and maintenance requirements to help ensure these vehicles and their emissions control systems are properly maintained.

- Continue to Provide Assistance to Fleets Operating Retrofits in On-Road and Off-Road Applications. The ARB will continue to investigate fleet concerns with retrofit performance in on-road and off-road applications.

30. U.S., Canada and Mexico Create New Climate Change Partnership

North American energy ministers have announced that they had set up a working group on climate change and energy, a partnership designed to help Canada, the United States and Mexico harmonize policies. The partnership does not include binding targets, but will enhance cooperation and integrate more climate change-related policies into energy discussions between the countries, Canadian Natural Resources Minister Greg Rickford said during a conference call.

All three governments said they will prioritize working together on issues, including efficiency of electricity grids, pursuing new clean energy technologies and aligning regulations to control emissions from the oil and gas sector.

The agreement comes even as Canada's right-leaning Conservative government and the Obama administration clash over the lengthy and ongoing U.S. review of TransCanada Corp proposed Keystone XL pipeline that would connect Alberta's oil sands region with the Gulf Coast of Texas.

Environmental groups have aggressively campaigned against the project, arguing that it would accelerate heat-trapping emissions from the oil sands.

Canada's government has criticized the Obama administration for delaying the decision, while U.S. President Barack Obama has questioned the economic benefits of the project, indicating he would not approve it if it exacerbates global warming.

Canada has also repeatedly pledged to introduce emissions regulations for the oil and gas sector in recent years, only to delay those plans. In December, Canadian Prime Minister Stephen Harper said it would be "crazy" to introduce new rules at a time when global oil prices are plummeting.

Rickford, who met with his North American counterparts in Merida, Mexico, said Canada could align itself with recently proposed U.S. rules to cut methane emissions from oil and gas operations as part of the agreement. He said this could lead to other regulations for Canadian oil and gas companies.

"I believe we've had some very serious discussions around the potential this (focus on methane) holds for oil and gas regs in general," said Rickford, following his meeting with Ernest Moniz and Pedro Joaquin Coldwell, the U.S. and Mexican energy secretaries, respectively.

Monday's agreement would also enhance cooperation on technologies to capture and bury greenhouse gas emissions underground, Rickford said.

31. California Governor Orders Aggressive Greenhouse Gas Cuts By 2030

California Governor Jerry Brown has issued an executive order to cut greenhouse gas emissions 40 percent by 2030, a move he said was necessary to combat the growing threat of climate change. The targeted reduction was tied to 1990 levels and is "the most aggressive benchmark enacted by any government in North America to reduce dangerous carbon emissions," Brown said in a statement.

California operates the nation's largest carbon cap and trade system. The state sets an overall limit on carbon emissions and allows businesses to hand in tradable permits to meet their obligations.

Achieving the new target will require reductions from sectors including industry, agriculture, energy and state and local governments, Brown said. "I've set a very high bar, but it's a bar we must meet," Brown told a carbon market conference in downtown Los Angeles.

Brown said the new target will position California as a leader in combating climate change in the United States and internationally. Brown said he has spoken to leaders in Oregon, Washington and Northeastern states about collaborating with California to cut their output of heat-trapping greenhouse gases. Those states could potentially link to California's carbon market in future years.

He said he has had similar discussions with leaders in the Canadian provinces of Quebec, British Columbia and Ontario, as well as in Germany, China and Mexico. Quebec is already linked to the California market. Leaders in Ontario this month signaled their intention to join the program. "This will be a local policy but it will be globally focused," Brown told reporters on the sidelines of the conference.

United Nations Secretary-General Ban Ki-moon welcomed the news and encouraged other states and cities around the world to also take action, U.N. spokesman Farhan Haq said. "California's bold commitment to tackling climate change is a strong example to states and regions all over the world that they can join their national governments in taking ownership of this critical issue and in showing leadership," Haq said.

The plan for how California will achieve the 2030 target will be hammered out over the next year by the California Air Resources Board (ARB), which oversees the cap-and-trade program. "With this bold action by the governor, California extends its leadership role and joins the community of states and nations that are committed to slash carbon pollution through 2030 and beyond," said Mary Nichols, chair of the ARB.

32. U.S. Climate Change Targets 'Achievable' but More Cuts Possible, Report Says

The U.S. commitment to reduce its greenhouse gas emissions by at least 26 percent by 2025 is achievable, but additional reductions are possible with stronger regulations and a greater emphasis on energy efficiency, the World Resources Institute said. The U.S. can achieve that emissions reduction target using existing executive authorities such as regulating carbon dioxide emissions from power plants and rules targeting additional emissions sources, the World Resources Institute said in its May 27th report, "Delivering on the U.S. Climate Commitment: A 10-Point Plan Toward a Low-Carbon Future."

According to the report, the U.S. could reduce its emissions by as much as 30 percent from 2005 levels by 2025 by strengthening its Clean Power Plan (RIN 2060-AR33), which would set carbon dioxide emissions standards for the power sector in each state, to foster additional reductions through energy efficiency and renewable generation.

The 10-point plan identifies opportunities for the U.S. to achieve emissions reductions, including regulating power plants; improving energy efficiency at residential and commercial buildings; introducing programs to reduce use of hydrofluorocarbons (HFCs); adopting stronger vehicle emissions standards; and regulating methane emissions from oil and natural gas systems, landfills and coal mines. The plan does not include measures to address greenhouse gas emissions from forestry or agriculture, however.

The Environmental Protection Agency's Clean Power Plan, which is expected to be finalized in August, would provide a significant portion of the projected emissions reductions. As proposed, the rule would account for 42 percent of emissions reductions in the World Resources Institute's base case scenario. But the group said in its report that the EPA's proposal could be strengthened to promote additional deployment of renewable energy and energy efficiency.

"We know the Clean Power Plan will accelerate these changes, but there's still some potential left there in terms of energy efficiency and renewables," said Karl Hausker, senior associate in the U.S. climate initiative at the World Resources Institute.

A stronger power plant rule coupled with new vehicle emissions standards and industrial energy efficiency requirements could reduce U.S. emissions by as much as 34 percent to 38 percent by 2030, the report said.

Following a panel discussion of the report, Rick Duke, deputy director for climate policy at the White House Office of Energy and Climate Change, was repeatedly asked during a question and answer period whether the White House would publicize the assumptions that led to its decision to adopt the 26 percent to 28 percent emissions reduction target and the steps the administration envisions will achieve that goal. Duke said the administration's plans were detailed in President Barack Obama's climate action plan, which ordered his administration to take steps to regulate power plant and vehicle emissions, as well as in biannual reports to the United Nations on the U.S.'s progress toward meeting its climate commitments.

He also said the World Resources Institute's report is further evidence that the U.S. targets are realistic and feasible. "This report from WRI is also consistent with our internal assessment that we're on track with both our 2020 and 2025 commitments," he said.

33. EPA Sends Biofuels Volumes Targets to White House for Review

The U.S. Environmental Protection Agency (EPA) has sent blending targets for the country's renewable fuels program to the White House for review ahead of a fast-approaching June 1 deadline for publicly releasing its proposal, according to industry sources. The EPA has reportedly sent proposed volume requirements for 2014, 2015 and 2016 to the White House Office of Management and Budget.

The EPA agreed to a June 1 deadline to issue targets for 2015 as part of a lawsuit settlement agreement with two oil industry groups over delays in the agency's target-setting. The agency also said it would propose 2016 volumes by June 1 and that it planned to re-propose 2014 requirements.

34. USDA Said Planning To Inject $100 Million on Ethanol Infrastructure

The U.S. Department of Agriculture (USDA) plans to inject $100 million in funding to get more ethanol at the gas pump, according to two industry sources, the latest push to get beyond a "blend wall" that has capped demand for the biofuel. That would mark a big push for an overhaul of fuel-blending pumps and related infrastructure to generate higher demand for the biofuel. The USDA is reportedly expected to announce the funding very soon.

Ethanol groups have asked the USDA to continue to offer this funding amid rising calls for policy reform from policymakers, oil companies, and environmentalists. The USDA launched a program in 2011 designed to get 10,000 flex-fuel options at gas pumps nationwide that would allow use of blends as high as E85, which is 85 percent ethanol.

The United States sets use requirements for biofuels, including ethanol, through the Renewable Fuel Standard (RFS) program, but has delayed setting targets for the current year and 2014 amid concern from oil companies that ethanol use has hit a saturation point without major infrastructure changes.

The plans come as oil companies and biofuels producers await a proposal from the Environmental Protection Agency (EPA) on biofuels use requirements for 2014, 2015, and 2016, widely expected to be announced very soon. (See above.)

35. EPA Delays Prompt $13.7 Billion Shortfall in Biofuels Investment: Report

U.S. government delays in rolling out renewable fuels policy have stymied some $13.7 billion in investments and have prevented advanced biofuels companies from meeting mandated target volumes, according to an industry group analysis. The U.S. Environmental Protection Agency's (EPA) slow rulemaking on the Renewable Fuel Standard program over the past two years has "chilled" an influx of capital needed to boost commercial production, according to the Biotechnology Industry Organization (BIO).

The Washington firm represents biotechnology companies like Abengoa Bioenergy and DuPont.

Production of advanced and cellulosic renewable fuels, which use plant waste as a feedstock, has failed to meet targets set by Congress in 2007, stoking debate over the policy. Corn-based ethanol represents the vast majority of renewable fuels in use.

The EPA has been late in meeting annual deadlines to set volumes of renewable fuels required to be blended into the transportation fuel pool, which critics say has created uncertainty throughout the industry. The agency is late in announcing mandates for both 2014 and 2015.

The EPA has to approve new ways companies have designed to qualify a fuel under RFS policy. Delays in that process have helped dry up funding, according to BIO.

36. Obama Moves to Slash Truck Pollution

The Obama administration has laid out a major step in its fight against climate change with a plan it said would reduce the greenhouse gas emissions from medium and heavy-duty trucks and buses by 1 billion metric tons. The matching regulations from the Environmental Protection Agency (EPA) and the Transportation Department would improve fuel efficiency standards by an average of 24 percent for medium-sized and heavy trucks, buses and big trailers through model year 2027, which would cut the output of Earth-warming carbon dioxide while saving 1.8 billion barrels of oil.

The federal agencies said the rules, which would be the second round of truck efficiency standards from the Obama administration, would bolster energy security and spur innovation in manufacturing while saving money for consumers and businesses.

Mark Rosekind, head of the Transportation Department's National Highway Traffic Safety Administration, said the rule would result in $270 billion in benefits nationally and only cost $25 billion. "Setting and implementing national standards for cars and trucks and other transportation sources has been a top priority for this administration, because cutting oil use is critical to our economic well-being and national security, while delivering cleaner air is important to the health and well-being of every American," he said. "And higher fuel efficiency helps us to bring these benefits to the nation, while bringing more money to the pockets of businesses and consumers."

While the new standards would add up to $12,000 to the cost of a new truck, trucking companies could recoup the costs within two years, leading the industry to $170 billion in fuel savings during the life of the vehicles.

Big trucks and buses account for about one-fifth of the greenhouse gas emissions and fuel use in the transportation sector, a sector that produces 27 percent of the country's emissions, second only to electricity generation. Those vehicles comprise only about 5 percent of the vehicles on the road.

The emissions reduction is the equivalent of the pollution from all United States residents' energy and electricity use for a year, while the oil savings amount to the country's annual imports from OPEC.

Janet McCabe, head of the EPA's air pollution office, said emissions from large vehicles are growing the fastest of any sector in transportation.

McCabe said that to reach the rule's goals, truck makers will have to use some technology that is not yet commercially available. But regulators believe the technology will be fully available by the time it is needed.

The rules come during a busy few months for the Obama administration's climate agenda. Earlier this month, the EPA kicked off a process to regulate greenhouse gases from aircraft (see story below.). In August, the administration plans to make final its most controversial climate change regulation, limiting carbon output from power plants. At some point this summer, the EPA will propose rules to crack down on methane emissions from the oil and natural gas sector.

But unlike some of Obama's more controversial rules, the truck regulations are receiving cautious support from the trucking industry. The American Trucking Associations (ATA) said it supports the rules, but it wants to make sure that the agencies do not mandate untested technology.

"Fuel is an enormous expense for our industry — and carbon emissions carry an enormous cost for our planet," Bill Graves, president of the trucking group, said in a statement. Glen Kedzie, who leads environmental policy for the ATA, said the federal government is generally following the advice that the industry suggested to keep technology attainable.

The industry fully supported the first round of truck efficiency rules, written in 2011.

Sen. Barbara Boxer (D-Calif.), top Democrat on the Senate Environment and Public Works Committee, applauded the "true leadership" Obama is showing through the rules. "This proposed truck fuel efficiency standard is another important step forward, because the reduction in carbon pollution will be the equivalent of taking more than 210 million cars off the road for one year," she said in a statement.

Environmental groups cheered the EPA's announcement. "Making our trucks go farther on less fuel will limit climate change and oil dependency while saving consumers and businesses money, and spurring innovation," Rhea Suh, president of the Natural Resources Defense Council, said in a statement. "We will be pushing the administration to require compliance sooner, in order to deliver these benefits more quickly."

Sara Chieffo, vice president of government affairs for the League of Conservation Voters, said the proposal "marks another important step in the Obama administration's plan to curb carbon pollution and combat climate change. A more efficient truck fleet will save money on shipping, driving down costs for companies and consumers."

The agencies will give the public 60 days to comment on the proposed rules, and will also hold public hearings on it throughout the country.

The proposed vehicle and engine performance standards apply to semi-trucks, large pickup trucks and vans, and all types and sizes of buses and work trucks. The ranges of CO2 emission and fuel consumption reductions necessary to meet the Phase 2 standards in model year 2027, relative to the respective 2018 vehicle categories, are:

- Class 8 tractors: Up to 24% emission reduction,
- Vocational vehicles: 12-16%,
- Commercial pickups and vans: 16%.

The technologies considered by the EPA/NHTSA include improved transmissions, engine combustion optimization, aerodynamic improvements and low rolling resistance tires.

The proposed Phase 2 standards maintain separate CO2 emission standards for complete vehicles and for engines. The engine standards have one advantage—the criteria of compliance are well defined and emissions are determined through physical testing using an engine dynamometer test bench, (Concerns have been raised that the proposal was weaker than expected on engine standards as some in industry had supported up to 10% improvement whereas the proposal only mandates 4% improvement.) Vehicle emissions, on the other hand, are determined though computer models that are not necessarily a perfect approximation of real vehicle emissions.

The proposal also includes efficiency and GHG standards for trailers (which were not included in the Phase 1 standards). The EPA trailer standards (which exclude certain categories such as mobile homes) would begin to take effect in model year 2018 for certain trailers, while NHTSA's standards would be in effect as of 2021, with credits available for voluntary participation before then. The efficiency technologies envisioned for trailers include aerodynamic devices, light weight construction and self-inflating tires.

The proposed standards are fully harmonized between the NHTSA and the EPA. The agencies have worked closely with the California Air Resources Board (ARB) in developing the proposed standards, said the EPA. In a statement on the EPA/NHTSA proposal, ARB Chairman M. Nichols said that the draft Phase 2 greenhouse gas regulations are a "positive next step for controlling emissions from trucks and other heavy-duty vehicles" and that the ARB will be working to ensure the final regulations help California meet its GHG emission reduction goals for 2030 and beyond. California harmonized its heavy-duty vehicle GHG program with the federal Phase 1 GHG standards in 2013.

37. California ARB Releases Draft Assessment of Heavy-Duty Truck Efficiency Technologies

The California ARB has published a Draft Technology Assessment that evaluates a range of technologies to increase fuel efficiency and reduce CO2 emissions from heavy-duty trucks. The release of the report coincides with the US EPA proposal for Phase 2 (post-2018) greenhouse gas (GHG) regulations. In April, the ARB published a related assessment of heavy-duty emission and fuel technologies.

The assessment found that the evaluated technologies can produce significant reductions in fuel consumption. Table 1 summarizes the potential additional fuel consumption reduction (FCR) beyond Phase 1 GHG standards (i.e., model year 2018) compliant vehicle that incorporates all of the applicable technologies.

Table 1: Potential additional fuel consumption reduction (FCR) beyond Phase 1 GHG standards

Vehicle Category	FCR Potential,	%
Heavy-Duty Tractor-Trailer (Class 7-8) Long Haul	8 -	36
Heavy-Duty Tractor-Trailer (Class 7-8) Short Haul	8 -	33
Heavy-Duty Vocational (Class 3-8)	10 -	28
Heavy-Duty Diesel Pick-ups and Vans (2b/3)	3 -	23
Heavy-Duty Gasoline Pick-ups and Vans (2b/3)	10 -	27

The percent FCRs shown in the table correspond directly to potential reductions in CO2 emissions, and can be used to help inform the Phase 2 GHG standard setting process, said ARB in the report.

California air quality targets also require significant further reductions in emissions of criteria pollutants, particularly NOx emissions. In the past, many NOx reduction technologies (such as exhaust gas recirculation and retarded ignition timing) have resulted in increased fuel consumption and reduced fuel efficiency. However, the introduction of urea SCR technology in 2010 allowed for increased fuel efficiency (and reduced GHG emissions) while achieving low tailpipe NOx emissions, noted the report.

The California ARB will further discuss NOx control technologies for heavy-duty engines (both diesel and natural gas) as part of three separate upcoming technology assessment documents expected to be released later this year: (1) Lower NOx Heavy-Duty Diesel Engines, (2) Heavy-Duty Hybrid Vehicles, and (3) Low Emission Natural Gas and Other Alternative Heavy-Duty Fuel Engines.

38. Truckers Brace for More Stringent California GHG Rules Following EPA Plan

Trucking industry representatives say they are bracing for California to propose more stringent greenhouse gas (GHG) regulations for heavy-duty trucks following last week's release of federal Phase 2 rules for the vehicles, fearing that they will be forced to comply with tighter standards from the state likely after the 2018 model year.

In addition, the industry is preparing for California to petition EPA to tighten nitrogen oxide (NOx) emission standards for heavy-duty engines for 2018 and beyond as some GHG controls boost NOx releases.

Even if the petition is rejected, California may still seek its own stringent NOx standards through the Clean Air Act waiver process, which effectively would amount to a national standard because the industry is unlikely to pursue two separate engine compliance paths, industry sources say.

EPA and the National Highway Traffic Safety Administration (NHTSA) last week released their harmonized proposals to further improve trucks' efficiency and curb their GHG emissions. (See story above.) The agencies said in a statement that they have worked closely with California officials and that all three agencies “are committed to the goal of setting a single set of national standards."

But following the proposal's release, California Air Resources Board (CARB) Chairwoman Mary Nichols released a written statement that welcomed the federal rules but kept open the option that California may adopt stricter rules. “We support this effort and will be working to ensure the final regulations help California meet our goals for 2030 and beyond," she said.

CARB added in the June 19 press release that it would “carefully review the draft federal Phase 2 regulations in light of” the state's efforts to reduce GHG emissions to 1990 levels by 2020 and Gov. Jerry Brown's (D) recently announced 2030 climate change target of 40 percent below 1990 levels, as well as the state's goal of halving petroleum use by 2030.

Some in industry reportedly believe that Nichols' comments and CARB's press release “virtually left the door open for CARB to take it up a notch,” potentially setting more stringent standards than EPA in its own Phase 2 GHG rule. “All bets are off beyond 2018, and hopefully we have at least the 2018 harmonizations."

In meetings industry officials have had with CARB over the past year, “it was quite evident CARB will create this program that is not harmonized across the country, and EPA will have to do catchup if they choose to get harmonization,” the source says. “And because of the long implementation period on this regulation, the next shot at doing that is going to be beyond some date post-2027, if they choose to have a round three” of the standards.

Because GHG controls can increase NOx emissions, trucking industry representatives have argued that reducing the pollutants are mutually exclusive endeavors, and have urged CARB to avoid setting its own more stringent standards for both pollutants.

One of the industry's “guiding principles” is to do everything possible to ensure there is one set of standards that every truck manufacturer can comply with, the source says. “We do not see a manufacturer putting up a production line for California-only trucks and one for the rest of the country -- that's not the way it works,” the source says.

“If California takes it up a notch, it will be the California requirements” that are followed, “which is really pushing the envelope in terms of how far technology and engineering can take us as an industry. . . . There's a lot of concern about what's happening in California.”

California's aggressive long-term GHG-reduction targets and its need to dramatically cut criteria pollutants to meet federal national ambient air quality standards in the coming decades are driving the state to pursue tighter engine rules. CARB's website says that upon EPA's adoption of its Phase 2 rules, "CARB staff plan to bring a proposed California Phase 2 program before the board, most likely in late 2016 or 2017."

CARB also revealed in a draft "sustainable freight" strategy released in April that it plans later this year to petition EPA to develop a lower NOx standard for new heavy-duty truck engines for rulemaking in 2018. The requested standard would be 0.02 grams NOx per brake-horsepower hour, which is 90 percent lower than EPA's 2010 model year on-road standard.

But some GHG-reduction technologies and processes, such as those that increase combustion chamber temperatures, have been shown to raise NOx emissions from engines. Trucking and engine manufacturing organizations have elevated this fact in debate with CARB officials over their regulatory plans.

CARB in 2013 harmonized its heavy-duty vehicle program with the federal Phase 1 GHG standards. But this will be the first time federal regulations have required large trailers to help achieve reductions in GHG emissions. CARB has had a GHG-reduction regulation in place for box-type trailers 53 feet and longer since 2010.

The federal proposal, which will be open for 60 days of public comment once it is published in the Federal Register, will regulate all classes of medium- and heavy-duty trucks including heavy pickup trucks, vocational vehicles and combination tractors from model years (MYs) 2021-2027. The rule will govern a longer period than what many had expected following industry lobbying to provide more production certainty.

Phase 2 will also regulate trailers used in combination with tractors for the first time beginning in MY2018. "Although the agencies are not proposing standards for all trailer types, the majority of new trailers could be covered," the proposal says.

The phase 1 EPA and NHTSA rules, which were aligned with California's, cover MY2014-2018.

EPA says in a fact sheet that when the standard is fully implemented in MY2027, combination tractor trailers will reduce their carbon dioxide (CO_2) and fuel use by 24 percent compared to the phase 1 standards. Trailers will see an 8 percent reduction alone, when compared to an average MY2017 trailer. And vocational trucks, pickup trucks and light vans will see a 16 percent cut compared to phase 1.

EPA will also seek comment on alternative approaches, including one that would require the same level of emission cuts two to three years earlier.

39. U.S. Researchers See Auto Fuel Efficiency Standards Driving Technology

In 2012 the U.S. National Highway Traffic Safety Administration (NHTSA), which regulates fuel economy, and the U.S. Environmental Protection Agency (EPA), which regulates greenhouse gas emissions, proposed new unified standards for fuel economy and greenhouse gas emissions over the years 2017 to 2025. The Corporate Average Fuel Economy (CAFE) standards require that vehicles offered for sale in the U.S. attain an average fuel economy of 40.3 to 41 mpg by 2021 and 48.7 to 49.7 mpg by 2025. These standards will require the U.S. new vehicle fleet to double in fuel economy between 2012 and 2025.

NHTSA plans to conduct a joint mid-term review with EPA to evaluate if technology development and implementation is on track to help automakers meet the standards. To inform the review, the National Research Council was asked to independently assess the CAFE/GHG national program, the technologies that are expected to contribute to meeting the standards, and possible impacts of the standards.

The analysis used by federal agencies to set standards for fuel economy and greenhouse gas emissions for new U.S. light-duty vehicles -- passenger cars and light trucks -- from 2017 to 2025 was thorough and of high caliber overall, says the Council report. In addition, the report finds evidence suggesting that the standards will lead the nation's light-duty vehicle fleet to become lighter but not less safe.

The report said fuel economy and greenhouse gas emission standards will drive new powertrain designs, alternative fuels, more advanced materials and changes to body vehicle design. Most of the reduction in fuel consumption will come from improvements to gasoline internal combustion engines, due to the continuing dominance of such technologies through 2025, the report says. However, the study committee that wrote the report considered a wide range of technologies to be critical in meeting the 2025 standards and beyond, including improvements to transmissions, reductions in mass, and hybrid/electric engines.

By the end of the next decade, because of the standards and other regulations, new vehicles will be more fuel-efficient, lighter, less polluting, safer, and more expensive to purchase compared with current vehicles.

The study was sponsored by the National Highway Traffic Safety Administration. The National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and National Research Council make up the National Academies. They are private, independent nonprofit institutions that provide science, technology, and health policy advice under a congressional charter granted to NAS in 1863. The National Research Council is the principal operating arm of the National Academy of Sciences and the National Academy of Engineering.

40. EPA to Consider Greenhouse Gas Rules for Aircraft after Endangerment Finding

Greenhouse gas emissions from aircraft endanger public health and the environment and should be regulated, the U.S. Environmental Protection Agency said in a proposed endangerment finding. The finding, released June 10, also includes an advance notice of proposed rulemaking where the EPA said it would likely follow international standards being developed should it complete its determination to regulate those aircraft emissions.

The United Nations' International Civil Aviation Organization is expected to complete an international carbon dioxide emissions standard for aircraft by February 2016 that the EPA will use as a template for its own rules.

Christopher Grundler, director of the EPA's Office of Transportation and Air Quality, said an international standard would capture more aircraft and provide more significant emissions reductions than a domestic rule alone would provide.

Should the EPA finalize its endangerment finding, Grundler said, the EPA doesn't anticipate completing any aircraft standards until 2018, which would leave the decision as to how to regulate those emissions to the next administration.

Airline operators praised the EPA's pledge to pursue international standards, but touted their efforts to improve fuel efficiency 120 percent since 1978, preventing 3.8 billion metric tons of carbon dioxide during that period. Aircraft account for 2 percent of total U.S. greenhouse gas emissions.

Environmental advocates were disappointed by the EPA's lengthy schedule for issuing any standards once it completes its endangerment finding and pressed the administration to seek emissions reductions beyond those the International Civil Aviation Organization is considering.

The EPA is proposing to find under Section 231 of the Clean Air Act that concentrations of six greenhouse gases—carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride—in the atmosphere endanger public health and the environment and that aircraft contribute to those emissions.

Those are the same six greenhouse gases the EPA identified in 2009 when it determined that emissions from cars and trucks should be regulated. That finding subsequently triggered regulation of stationary sources such as power plants.

The proposed endangerment finding wouldn't apply to small piston-engine planes or to military aircraft.

The EPA in September 2014 agreed to undertake the endangerment finding for aircraft after Earthjustice, Friends of the Earth and the Center for Biological Diversity threatened to sue the agency for failing to respond to their petition seeking the regulation.

Determining which aircraft would be covered by any potential standards will be key to determining how significant the emissions reductions are that can be achieved.

The EPA in its advance notice of proposed rulemaking is seeking comment on how to structure the rule, whether it should regulate only new aircraft models or whether it should also be applied to models currently in production.

Few new aircraft models will be introduced by the 2023 implementation date, the EPA said. A standard that targeted emissions from only those aircraft would provide almost no carbon dioxide emissions reductions for several years until those new models form a significant portion of the airline fleet, the agency said. "If the international CO2 standard is applied only to new aircraft types, then CO2 emissions would not be expected to begin to deviate from business-as-usual (in comparison to CO2 emissions reductions that would be achieved in the absence of a standard) before 2025," the EPA said. "Therefore, an international standard developed for only new aircraft types may not actually apply to any new aircraft for at least a decade."

The EPA also is seeking comment on an option the International Civil Aviation Organization's Committee on Aviation Environmental Protection is considering that would redefine new aircraft to include those that are in production but have made modifications to the design that would result in changes in carbon dioxide emissions. That would capture improvements to aircraft such as redesigned wings and new engine models, the EPA said.

Aviation accounted for 11 percent of energy-related carbon dioxide emissions from the transportation sector in 2013, and nearly 30 percent of global aircraft emissions in 2010, the latest year with complete global emissions data.

International Council on Clean Transportation Program Director Dan Rutherford said that to ensure real emissions reductions from airlines, ICAO should apply a carbon dioxide standard to all new aircraft delivered after 2020. But ICAO is weighing a standard that would apply only to new designs certified after the expected application date of Jan. 1, 2020. Such an approach would mean the standard would only cover about 5 percent of the global aircraft fleet in 2030, he said.

41. US EPA Proposes Renewable Fuel Standards for 2014-2016

The US EPA has issued their proposal for volume requirements under the Renewable Fuel Standard (RFS) program for the years 2014, 2015 and 2016, and also proposed volume requirements for biomass-based diesel for 2017. The proposal was released on May 29, adhering to the schedule in a recent consent decree with the fuel industry.

The EPA has proposed to establish the 2014 standards at levels that reflect the actual amount of domestic biofuel used in that year; the standards for 2015 and 2016 (and 2017 for biodiesel) increase steadily over time, as shown below.

Table 1: Proposed Renewable Fuel Volumes (millions of gallons)

	2014	2015	2016	2017
Cellulosic biofuel	33	106	206	N/A
Biomass-based diesel	1,630	1,700	1,800	1,900
Advanced biofuel	2,680	2,900	3,400	N/A
Total renewable fuel	15,930	16,300	17,400	N/A

Units for volumes are ethanol-equivalent, except for biomass-based diesel volumes which are expressed as physical gallons.

Table 2: Proposed Percentage Standards	2014	2015	2016
Cellulosic biofuel	0.019%	0.059%	0.114%
Biomass-based diesel	1.42%	1.41%	1.49%
Advanced biofuel	1.52%	1.61%	1.88%
Total renewable fuel	9.02%	9.04%	9.63%

While the proposed volumes are lower than the Clean Air Act targets—for total renewable fuels, the Clean Air Act (CAA) target is 18,150 millions of gallons for 2014; 20,500 for 2015; and 22,250 for 2016—they represent growth over historic levels. For example:

- The proposed 2016 standard for cellulosic biofuel is six times higher than actual 2014 volumes. Cellulosic biofuels have the most aggressive growth schedule among all renewable categories, from 33 million gallons in 2014 to 206 million gallons in 2016.
- The proposed 2016 standard for total renewable fuel is nearly 1.5 billion gallons more, or about 9% higher, than the actual 2014 volumes.
- The proposed 2016 standard for advanced biofuel is more than 700 million gallons—27%—higher than the actual 2014 volumes.
- Biodiesel standards grow steadily over the next several years, increasing every year to reach 1.9 billion gallons by 2017—17% higher than the actual 2014 volumes.

The proposal was long overdue—Under the CAA, the EPA has an obligation to set the annual RFS mandates by 30 November of the preceding year, but the EPA has not yet issued the 2014 or 2015 requirements (the EPA proposed RFS volumes for 2014, but never finalized the rule). In March 2015, the American Petroleum Institute (API) and the American Fuel and Petrochemical

Manufacturers (AFPM) filed a lawsuit over EPA's failure to meet mandated RFS deadlines. Under a proposed consent decree, the EPA has committed to propose the 2015 standards by June 1, 2015, and to finalize the volume requirements for 2014 and 2015 by 30 November 2015.

The proposal is open for public comments until 27 July 2015.

Shortly after the release of the proposal, EPA defended its handling of the program at a congressional hearing. At the hearing by the Senate subcommittee on regulatory affairs and federal management, U.S. lawmakers criticized the agency for years-long delays to quotas and for last month setting unattainable targets for the amount of corn-based ethanol and other biofuels that must be used in the nation's motor fuel supply over the next two years. They also questioned the future of the decade-old Renewable Fuels Standards (RFS), which critics say has inflated prices of food and fuel at the pump.

The panel will likely increase congressional attention to the pitfalls of the decade-old biofuels policy as it faces a fresh wave of criticism from policymakers, the oil industry and environmentalists. But it appears that a major legislative overhaul, which would need approval in Congress, is unlikely with an election less than two years away.

While acknowledging delays created uncertainty in the ethanol market, Acting Assistant Administrator Janet McCabe reaffirmed the agency's stance that the new targets sought to ensure growth of the U.S. renewable fuel industry while also going some way toward meeting goals set by Congress in 2007. She told the panel the latest targets are "ambitious but responsible." Still, the EPA is already looking at the possibility it will need to reset biofuels use targets in 2017 and beyond, McCabe said.

At the hearing, James Lankford, a Republican Senator and the subcommittee chairman, attacked the RFS for artificially pushing corn-based ethanol into the motor fuel stream without environmental benefits. "We must ask ourselves if the RFS goals of yesterday are worth the increased costs to our food, gas and the environment," said the senator from Oklahoma, an oil-rich state, in opening remarks.

Introduced in 2005 and a pillar of two presidential administrations, the RFS was aimed at cutting America's dependence on foreign oil and shift the nation to cleaner energy sources.

Supporters refute claims that the policy increases costs and the EPA said it sees no net increase in fuel prices from the program.

Oil companies including Tesoro Corp have threatened legal action to fight the latest proposal, while corn-based ethanol producers, like Archer Daniels Midland Co, say the rules don't go far enough.

42. Supreme Court Upholds $72M Volvo Powertrain Verdict

The U.S. Supreme Court let stand a ruling ordering Volvo Powertrain Corp. to pay $72 million for building engines that did not meet emissions standards, even though they never entered the United States. Without comment, the court did not take up a federal appeals court ruling that upheld a lower court decision that ordered the fine for the unit of Swedish conglomerate AB Volvo for producing 8,354 2005 MY engines that did not comply with EPA's nitrogen oxide emissions standards.

In 1998, the Environmental Protection Agency sued seven major engine manufacturers, alleging that they had been using "defeat devices" to meet EPA standards for emissions. The devices enabled the engines to meet EPA emissions standards in laboratory testing even though the engines produced emissions far above the legal limits in ordinary use.

The seven didn't admit using the devices but collectively agreed to penalties of about $80 million. They also agreed that diesel engines would meet tougher rules one year ahead of schedule — in the 2005 model year — as part of the deal.

In September 2005, a tip from Caterpillar Inc. — a competing engine manufacturer — prompted an investigation into Volvo's 2005 Volvo Penta engines. After nearly seven years of legal battles, a federal district court found Volvo owed $72 million for not complying with the agreement, including $6 million in interest.

The California Air Resources Board also sued Volvo Powertrain for violating the consent decree.

A number of major business groups had urged the Supreme Court to take the Volvo Powertrain appeals, including the National Association of Manufacturers and American Petroleum Institute, arguing that EPA should not have the ability to "assess penalties on the basis of foreign emissions from engines that never entered the United States." The business groups argued that "EPA's power-grab would extend the agency's authority extraterritorially, with foreign policy implications that the agency is not equipped to take into account," they wrote.

The company had sought certificates of conformity from EPA in order to import the engines for sale from a factory in Sweden.

The Justice Department noted that the EPA certificates are valuable even outside the United States because of the secondary market for engines. It called the argument from Volvo Powertrain and outside groups "flawed" because it is "neither illegal nor anomalous" for consent decrees to go beyond what federal law requires.

43. US Supreme Court Strikes Down Obama's EPA Limits on Mercury Pollution

The US Supreme Court struck down rules for America's biggest air polluters, dealing a blow to the Obama administration's efforts to set limits on the amount of mercury, arsenic and other toxins coal-fired power plants can spew into the air, lakes and rivers. The 5-4 decision was a major setback to the Environmental Protection Agency (EPA), and could leave the agency more vulnerable to legal challenges to its other new carbon pollution rules, from industries and Republican-led states.

The justices embraced the arguments from the industry and 21 Republican-led states that the EPA rules were prohibitively expensive and amounted to government overreach.

But the EPA pointed out that most plants had already either complied or made plans to comply with the ruling. "EPA is disappointed that the court did not uphold the rule, but this rule was issued more than three years ago, investments have been made and most plants are already well on their way to compliance," the agency said in a statement..

According to data compiled by SNL Energy, many generators in the US complied with the mercury and toxics requirements, despite the possibility that the court would strike down the rule. The data showed that 200 plants, or roughly 20% of the US generating capacity, were given up to an extra year to comply with the standards, mostly in order to finish installing mercury controls.

Plants moved ahead with compliance plans due to the long lead time for environmental control projects, SNL said. The compliance deadline fell in April of this year.

The EPA "remains committed to ensuring that appropriate standards are in place to protect the public from the significant amount of toxic emissions from coal and oil-fired electric utilities and continue reducing the toxic pollution from these facilities," the agency added.

Monday's decision, written by Justice Antonin Scalia, ruled that the EPA did not reasonably consider the cost factor when drafting the toxic air-pollution regulations.

The Clean Air Act had directed the EPA to create rules to regulate power plants for mercury and other toxic pollutants that were "appropriate and necessary".

The agency had previously said it did not need to consider costs during that stage of the regulatory process. The agency estimated that the cost of its regulation to power plants would be $9.6bn a year, but it said that its analysis "played no role" in whether regulations were deemed "necessary and appropriate".

The EPA also estimated that the rule would produce up to $37bn-$90bn in benefits and would prevent up to 11,000 premature deaths and 130,000 asthma cases each year.

The EPA rule took effect for some plants in April and was due to go into full effect by next year. In the meantime, the rule remains in effect, lawyers working on the case told the press. The ruling only concerns the cost consideration, so the EPA may try to write the rule again with cost in mind.

Scalia was joined in overturning the rule by the more conservative members of the bench, Chief Justice John Roberts, Clarence Thomas, Samuel Alito and Anthony Kennedy. The dissent, written by Elena Kagan, was supported by Ruth Bader Ginsburg, Stephen Breyer and Sonia Sotomayor.

In his majority opinion, Scalia called the EPA's counterarguments "unpersuasive". In her dissent, Kagan said that the majority decision was "micromanaging" EPA's rule-making, "based on little more than the word "appropriate".

Kagan also said that the court's invalidation of the EPA's rule because the agency had not considered cost at the initial stage of the regulatory process was a "blinkered" assessment, considering the "subsequent times and ways EPA considered costs in deciding what any regulation would look like".

The landmark decision is the latest chapter in a two-decade-long effort to force stricter emissions standards for coal-fired power plants. The regulation, adopted in 2012, would have affected about 600 coal-fired power plants across the country – many of which are concentrated in the Midwest and the south.

It was already going into effect across the country. But Republican governors and power companies challenged the EPA's authority, saying the agency had mishandled estimates of the cost of the new rules.

The decision was also a blow to years of local efforts to clean up dangerous air pollution.

The Supreme Court has now sent the case back to the Washington DC circuit court of appeals, which will ask the EPA to reconsider its rule-making. Activists are now urging the EPA to act definitively and quickly to issue revised regulation.

44. Climate Change Growing Threat to Public's Health, Not Just Planet's: U.S. Officials

The White House wants to start a national dialogue on why climate change isn't just bad for the planet's health but for the public's health, too. Climate change brings with it a host of public health problems, from more intense heat waves to longer allergy seasons to higher risks of Lyme disease. Children, the elderly, the sick, the poor and some communities of color will feel the brunt of these impacts, according to federal research.

So to help spread the word, the White House hosted a summit June 23 on climate change and health, bringing together administration officials, doctors, deans of medical schools and others to talk about how Americans will be affected and what they can do to prepare.

President Barack Obama, who addressed the summit via a pre-taped video message, said, “Evidence of climate change is no longer relegated to decades of carefully collected scientific data. “It's something that we can increasingly see and feel as we step out our front doors,” he said, on a day when temperatures in Washington reached near-record levels.

The summit was part of a communications push from the Obama administration marking the second anniversary of the president's plan to tackle climate change. A day earlier, the Environmental Protection Agency released a report outlining the impacts of a changing climate on the U.S. economy and the benefits of taking action (See related story.).

EPA Administrator Gina McCarthy said that report was part of an effort to make Obama's executive actions on climate change resonate better with what she called “normal human beings.” “When I put a report out on acting on climate like we did yesterday—that shows how dramatically our world will change if we don't act and the benefits we can deliver if we do—I am doing that not to push back on climate deniers,” McCarthy said. “In any democracy, it's not them that carries the day. “It is normal human beings that haven't put their stake into politics above science,” she said. “It's normal human beings who want us to do the right thing, and we will if you help us.”

The president has made climate change a centerpiece of his second term, issuing a suite of new policies, including the first-ever curbs on greenhouse gas emissions from power plants. Health was a focal point of the administration's messaging when those rules were proposed.

Part of the reason for the emphasis on health is that it is a much less polarizing issue than climate change, said Edward Maibach, director of George Mason University's Center for Climate Change Communication. “All Americans feel strongly about their health,” he said at the summit, but the problem is they don't know how climate change will affect them.

Most Americans either have no idea people will die, get sick or injured by climate change or they underestimate how many people will be affected each year, according to surveys conducted by George Mason and Yale universities. Yet, in the British medical journal Lancet, a panel of 46 health professionals and climate scientists just identified the world's changing climate as one of the biggest threats to humans in the coming decades.

Administration officials at the summit also pitched climate change's impact on health as a moral issue, building on the argument that Pope Francis made a week earlier in a ground-breaking encyclical. “My concern is that, among other things, climate change has the potential to worsen not only health overall but also worsen disparities in health,” Surgeon General Vivek Murthy said, referring to its outsized impact on children, the elderly, the poor and minorities. “For that reason, I believe that climate change is a moral issue.”

Brian Deese, one of the president's top climate advisers, likewise made an appeal as a parent, saying, “For many of us, this issue starts at a very personal level. We need to make sure that people know why we are pushing so hard in this fight against climate change. And at the end of the day, that comes back to the health of our children and the health of our families and our communities.”

45. EPA Report on Costs, Benefits Bolsters Argument for Global Action on Climate Change

The Environmental Protection Agency bolstered its case for global action to address climate change in a June 22nd report that details the benefits of reducing greenhouse gas emissions. The report, “Climate Change in the United States: Benefits of Global Action,” looks at the benefits of global greenhouse gas mitigation across water resources, electricity, infrastructure, public health, agriculture and forestry and ecosystems and details the risks of failure to act. The data were collected as part of the EPA's ongoing Climate Change Impacts & Risk Analysis project.

“Left unchecked, climate change threatens our health, our infrastructure and the outdoors we love, but more importantly, the report shows that global climate action to cut carbon pollution will save lives, it will reduce the damages and it will avoid costs,” EPA Administrator Gina McCarthy told reporters at a White House briefing. “It's really not too late to avoid the worst impacts of climate—which is a very hopeful sign—but it really relies on us taking action soon and making that action significant.”

Both the report methodology and the scientific underpinnings were peer-reviewed, officials said. The EPA developed the report in collaboration with the Massachusetts Institute of Technology, Pacific Northwest National Lab, National Renewable Energy Laboratory and other organizations.

Taking action to keep global temperature increases below 2 degrees Celsius would prevent 57,000 deaths from poor air quality in 2100, the report said. Taking action on climate change could also avoid $110 billion in lost labor due to rising temperatures in 2100.

Reducing greenhouse gas emissions also could benefit the power sector, the report said, saving the industry between $10 billion and $34 billion in costs by 2050. In addition, climate mitigation could reduce coastal property damage from sea level rise from $5 trillion through 2100 to $810 billion.

The report comes on the second anniversary of President Barack Obama's climate action plan, which directed federal agencies to take action to reduce greenhouse gas emissions. As the centerpiece of that plan, the EPA in August will finalize carbon dioxide emissions standards for both new and existing power plants.

The report does not evaluate the benefits and costs of any specific greenhouse gas mitigation strategy or adaptation policies.

46. On Capitol Hill, Lawmakers See Little Effect on Their Work from Pope's Climate Call

Amid great international fanfare about the potential impact of Pope Francis's call to climate action (see story below), Democrats and Republicans in Congress were skeptical on June 18th that the pontiff's encyclical would significantly boost the chances for U.S. legislative action on the issue.

Democrats were nearly unanimous in lauding the pope for taking on the issue and predicted his decision to frame climate change as a moral issue would carry heavy weight internationally. But they also doubted it would sway the minds of Republicans—many of whom deny that climate change is either occurring or is caused by human activity—to reconsider their positions.

Coalescing around a theme they have returned to time and time again in recent days, Republicans said the pontiff had the right to express his views on the climate issue but then declined to address the second part of his message, which challenged nations to act.

“Well, one thing we know about this pope is he's not afraid to challenge everyone's thinking on issues, frankly, one way or another, and I admire his dedication to the poor and his work to protect the sanctity of life,” House Speaker John Boehner (R-Ohio) said. “And frankly, I respect his right to speak out on these important issues,” Boehner said at his weekly press conference. But asked if the pontiff's message might spur congressional action, Boehner said he was unsure. “There's a lot of bills out there. I'm not sure where in the process these bills may be,” he said.

Few, if any, observers seriously expect Congress to tackle broad actions on climate change anytime soon. Democrats blame Republican skepticism or outright denial of the problem for the inaction. “It's important that the pope does [weigh in],” Sen. Bob Casey (D-Pa.) told reporters. “I think the policy debate here, though, is going to be a challenge.”

Francis released the 183-page document June 18 urging a strong response to rising temperatures worldwide and linking the issue to a theme he has returned to repeatedly during the past two years: the need for a global response to poverty.

Republicans almost universally declined to directly criticize the pope for wading into the contentious issue, but also declined to say whether his message might sway their own views.

- “Pope's the pope,” Sen. Lisa Murkowski (R-Alaska), chairman of the Senate Energy and Natural Resources Committee, told reporters. “He can talk about whatever he wants.”
- Sen. Cory Gardner (R-Colo.) said that any message from the pope was likely to draw interest around the world. “It's his right to express opinions and concerns,” Gardner said.

But one senator took exception to the idea that Pope Francis should insert himself in the climate debate. “I think he ought to be focused on other issues,” said Sen. John Barrasso (R-Ky.).

Though most Democrats were skeptical that the pope's encyclical would have any impact on Congress, many expressed optimism that it would play a larger role in international negotiations under way to seal a global climate accord at in Paris later this year.

- “As Pope Francis so eloquently stated this morning, we have a profound responsibility to protect our children, and our children's children, from the damaging impacts of climate change,” President Barack Obama said in a statement. “And as we prepare for global climate negotiations in Paris this December, it is my hope that all world leaders—and all

God's children—will reflect on Pope Francis's call to come together to care for our common home."

- House Minority Leader Nancy Pelosi (D-Calif.) called the encyclical a potential breakthrough in that push for global climate action. "This church has not spoken on this subject, and so he is breaking new ground in terms of climate," she said at her weekly press conference. "What he's talking about is new ground," said Pelosi, who pushed a climate bill to passage in the House in 2009; the legislation died in the Senate in 2010.

Outside of Congress, too, observers saw an encyclical that repeatedly returned to what most scientists say is a consensus that human activity contributes to climate change. The pope's words potentially could sway minds around the world, they said.

"I find that the pope's decision to start with empirical data ... shows his and the church's deep respect for the world of science and the understanding that it is a domain of its own," Cardinal Donald Wuerl, the archbishop of Washington said at a National Press Club forum. "And so he begins with what is evident data. It saves the encyclical from being dismissed as simply abstract reflection." Wuerl also said the copies of the encyclical he and other church leaders received came with a handwritten note from the pope, which highlighted the need for humans to "care for our common home."

Other senior members of the Roman Catholic Church also took aim at Republican presidential candidates—like former Florida Gov. Jeb Bush (R) and former Sen. Rick Santorum (R-Pa.)—for questioning the pope's decision to wade into the debate. "We talk about these subject matters not because we are experts on those matters; we talk about them because they concern the impact on our lives," Cardinal Peter Turkson, a papal adviser who helped write the encyclical, said June 18 at the Vatican. "The Republicans and presidential figures who say they will not listen to the pope, it is [a] freedom of choice that they can exercise," he said.

- Bush said June 17 that he wouldn't take his cues on how to address climate change from religious leaders. "I hope I'm not going to get castigated for saying this by my priest back home, but I don't get economic policy from my bishops or my cardinal or my pope," Bush said in New Hampshire. "I think religion ought to be about making us better as people and less about things that end up getting in the political realm," Bush said.
- Santorum told a radio show in early June that "the church has gotten it wrong a few times on science, and I think that we probably are better off leaving science to the scientists" and having the church stay focused on theology and morality.

Candidates for the Democratic presidential nomination strongly embraced Pope Francis' encyclical and expressed optimism his words could profoundly impact global efforts to address climate change.

- "I applaud the pope and I think [the encyclical] is going to have an international impact because one of the great religious leaders of the world is telling us climate change is real and has got to be addressed," said Sen. Bernie Sanders (I-Vt.), who caucuses with Democrats and is seeking to be their presidential nominee.
- Coinciding with the encyclical's release, former Gov. Martin O'Malley (D-Md.) released his plan for powering the U.S. on 100 percent clean energy by 2050. Echoing a phrase from the pope's encyclical, O'Malley said there is a "moral obligation" to act immediately and aggressively to stop climate change.

ASIA-PACIFIC

47. What's Behind Delhi's Air Pollution?

What is poisoning Delhi's air and making India's capital the most polluted city in the world? The government has taken on the National Green Tribunal, contesting that old private vehicles plying in the National Capital Region are not significant contributors. It has marshalled some science to defend its claim. But, it has also conveniently ignored well known public health studies that contradict its stance. The tribunal will decide on the matter on July 13th.

The NGT had earlier ordered a ban on all diesel vehicles over 10 years of age in the Delhi-NCR region and petrol vehicles older than 15 years - commercial or private. But as the government protested, it put the ban on hold, hearing the government out.

The Union ministry of road transport and highway commissioned a quick analysis to IIT Delhi to look at what impact the NGT ban on private vehicles would have on the city's pollution. The study looked only at old private vehicles and said their overall contribution to one particular pollutant - particulate matters below 2.5 micron (PM2.5)-was negligible and so banning them would not pay off. The IIT-Delhi study also said that the number of 11-15 years-old diesel cars is very small - only 6 per cent of the fleet and contributes 1 per cent of PM2.5 pollution. The government consequently demanded they be allowed to ply.

In doing so, the government side-stepped studies which suggest that the public health priority must be set by not just measuring the pollutants in the air (ambient pollution) but also by discovering what pollutants people in a city end up breathing in the most (exposure levels to pollution) and what is the source of that pollution.

Since vehicular emissions take place within our breathing zone, living between 200 and 500 meters of a major road has severe consequences for public health in the long run. This was concluded by the Boston-located Health Effect Institute, which mapped that more than half of Delhi's population lives within 500 meters of a freeway and 50 meters of a major road. Unlike in cities of developed countries, the institute noted that in cities like Delhi populations are clustered differently in the urban spaces. Consequently, the public health mandate requires a different focus in any developing country.

"We may have power plants at a distance or an industrial zone which has other polluting sources but vehicular pollution poisons the air we breathe every day and has to be a priority," says Anumita Roy Chowdhury of Centre for Science and Environment.

She points out that diesel fumes are now designated as a class I carcinogen by the World Health Organization - a lung cancer causing cocktail of chemicals in the air. The IIT-Delhi study also focuses on just PM2.5 while ignoring the public health burden of other pollutants that vehicles emit like Nitrous Oxides (NOx). Even small amounts of such chemicals in the air are harmful and whatever can be done to reduce them is necessary, show studies.

The IIT Delhi study relies on previous work done to apportion the pollution to different sources - vehicles, diesel gensets, power generation units and others. But many critics have called this 'source apportionment study' misleading. The report commissioned by the government is used often to show that vehicles are not as much to blame for the foul air. Indian Institute of Tropical Meteorology's study for Delhi-NCR in comparison found that transport sector's contribution to

PM2.5 pollution was as high as 45 per cent. Another 2008 study by Jawaharlal Nehru University also found vehicles contributing 86 per cent of fine particulates that pollute Delhi's air.

The IIT-Delhi report notes that many old vehicles that are registered with the authorities do not really ply on the NCR roads. But Roy Chowdhury notes that, according to the Automotive Research Association of India's research, emissions from one old diesel car (manufactured before 2005) equal those from four to seven new cars. Compared to a BS IV car, a 15-year-old diesel car emits 7.6 times higher particulate matter and 3.4 times higher NOx. A 10-year-old diesel car emits 2.4 times higher particulate matter. Air toxics emissions are high from older vehicles.

Using the IIT report, the government has advocated focusing on long-term reforms that would bring improvement to Delhi's air. One of them is improving the quality of fuel used in vehicles. That is expected to happen only in 2020 at the earliest.

"It's not a choice of one versus the other. We need to act on all fronts - measures that will help in the short run and fix the problem over long term as well," Roy Chowdhury notes. She says that cities like Beijing have done so -they have banned old vehicles from plying and pro-actively follow a scrapping policy. As long as the new cars that replace the old ones use cleanest technology, there is value in having such a policy.

The government insists that regular pollution control checks could suffice to ensure old vehicles are not polluting. But these tests only measure smoke density. Even the standard for that is lax as compared to other developing countries. Then, the smoke density test does not measure other pollutants which are equally, if not more, harmful.

In the last hearing of the tribunal, the ministry has put forth more studies bolstering its position, while the NGT has indicated that it is unwilling to take the government's selective referencing of science at face value. It noted that the government was providing information only to defend the right to ply old private vehicles, though the NGT order had also focused on old commercial vehicles.

As has often been the case with regulating Delhi's air pollution, the lead is again being taken by the courts. The last big leap the courts forced on the government was shifting the city's public transport to CNG from diesel. The advantage gained from that over more than a decade has been negated by an increase in the number of vehicles on Delhi's roads. The government's decision to put out an easy-to-read air pollution index has helped citizens digest the complicated science of air pollution. But the ministry of road transport and highways, it seems, is still to figure out a way to solve Delhi's pollution problem.

48. India Proposes Standards to Cut Air Pollution from Coal-Fired Power Plants

India's Ministry of Environment, Forests and Climate Change has proposed emissions standards for coal-based power plants with the goal of significantly cutting emissions of particulates, sulfur dioxide, nitrogen oxides and mercury. India currently has no such standards at its coal-fired power plants.

Starting January. 1, 2017, power companies will be required to cut particulate emissions from new plants by 25 percent, sulfur dioxide emissions by 90 percent, nitrogen oxides emissions by 70 percent and mercury emissions by 75 percent, according to the standards, proposed on May 18th.

New Delhi-based public interest research organization Centre for Science & Environment (CSE) said if the proposed changes are implemented, they could go a long way in safeguarding public health and the environment. CSE said the energy efficiency of India's plants is now among the lowest in the major coal-based power producing countries.

Also, existing cooling tower-based plants would be required to restrict water consumption to 3.5 cubic meters per megawatt hour. Plants coming online after January 2017 would have to achieve 2.5 cubic meters. Also, all existing once-through-cooling system plants would have to be replaced with cooling tower-based systems that consume no more than 4 cubic meters per megawatt hour.

“This can have a remarkable reduction in freshwater withdrawal by thermal power plants,” said CSE. “Cumulatively, freshwater withdrawal will decrease from around 22 billion cubic meters in 2011–2012 to around 4.5 billion cubic meters in 2016–2017, an 80 percent dip.”

The proposal is open for stakeholder comment until June 18.

Thermal power dominates the Indian electricity sector, accounting for 71 percent of installed capacity, according to the Energy Research Institute, based in Delhi. Coal is the dominant fuel in the power sector, contributing 60 percent of the total installed capacity.

49. Beijing Takes Next Important Steps

The Beijing EPB has announced that Beijing is going to implement the China V/Beijing V standard for new heavy diesel vehicles starting from June 1st. The standard is primarily China V with additional local requirements. Below are the key elements of the announcement.

- Starting from Jun 1, 2015, all new heavy-duty diesel vehicles to be sold (certified) in Beijing must meet China V emission standards and two additional Beijing local standards -- WHTC limits and PEMs limits.
- Starting from Jan 1, 2016, new public HDDVs (buses, sanitation, postal, tour coaches, shuttles etc.) must install DPF
- Starting from Aug 1, 2015, China IV new HDDVs can no longer register in Beijing (incl, locally produced and sold, or transferred vehicles from outside Beijing).

50. Non-Automotive Diesel Fuel in China to Meet New Quality Standards In 2018

Diesel used outside the automotive sector will have to meet the "National V" fuel quality standards by January 2018, a year later than automotive fuels, China's powerful central planning authority said, as the government continues to battle rampant smog. China earlier moved up implementation of the new quality standards for automotive fuels to the beginning of 2017, excluding so-called "general" diesel used in agriculture and industry.

Starting next year, China will expand the areas receiving automotive gasoline and diesel that meet the standards to 11 eastern provinces and cities, before rolling them out nationwide in 2017.

In 2018, the Chinese market will need a supply of 52 million tons, or 388 million barrels, of "general diesel", the central planning authority, the National Development and Reform Commission (NDRC), said. "Building on the basis of upgrading automotive gasoline and diesel can speed up the refitting of main refineries in order to upgrade general diesel ... and safeguard the domestic market supply of automotive and general diesel," the NDRC said.

The fuel standards are similar to quality specifications of Euro V, which has a maximum sulfur content of 10 parts per million (ppm).

51. China to Implement Strict Auto Fuel Standard Early

China will start implementing stricter diesel and gasoline standards a year earlier than scheduled to reduce vehicle emissions as part of a broader plan to control air pollution. The government will expand the adoption of the new emissions standard, equivalent to Euro V, to 11 provinces in eastern China on Jan. 1, 2016, the National Development and Reform Commission said in a statement May 7. The new standard, known as "China V," which is cleaner and has a lower sulfur content than most fuel used today in China, will take effect nationwide from Jan. 1, 2017, a year earlier than was previously announced, according to the statement. The government will increase policy support to refining companies to upgrade fuel quality, the commission said.

52. China Removes Key Tax on Electric, Hybrid, Fuel Cell Commercial Vehicles

China has extended a tax exemption already available to consumers who buy the most fuel-efficient cars to companies purchasing similarly green vehicles for business purposes. China's State Council announced that electric, plug-in hybrid and fuel-cell commercial vehicles will be exempt from the country's so-called vessel tax, which traditionally is applied to new cars, trucks and commercial vehicles at the time of purchase.

The country's main decision-making body also said buyers of certain gasoline and diesel passenger vehicles—those that meet strict fuel-economy requirements—will have their vessel tax cut in half.

The measures, effective immediately, are meant to spur sales of electric and hybrid vehicles and reduce fuel consumption and air pollution, according to a May 18th announcement from the State Council.

All-electric, plug-in hybrid and fuel cell passenger vehicles already were exempt from the vessel tax, which varies widely depending on a vehicle's engine displacement and fuel efficiency.

The State Council also announced on May 18th that it will gradually alter subsidies that go to operators of commercial new-energy buses to encourage their widespread use. The state-level municipalities of Beijing, Tianjin and Shanghai, and the provinces of Hebei, Shanxi, Jiangsu, Zhejiang, Shandong, Guangdong and Hainan will aim to have 40 percent of their public buses operating on all-electric, hybrid or fuel-cell technology by the end of 2015 and 80 percent by the end of 2020. Other provinces have lower targets.

"The core of this policy change is to encourage the use of new energy buses and set a mechanism to limit the growth in the use of buses operating on fossil fuels," Bai Jingming, branch deputy director under the Ministry of Finance, said in a statement.

Vice Premier Ma Kai said the country would be more aggressive in installing charging stations for such vehicles, according to a separate State Council announcement May 18.

53. After Generous Subsidies Next Year, China to Slash Incentives to Buy Cleanest Cars

China said government subsidies to encourage the purchase of the most fuel-efficient motor vehicles will be scaled back beginning in 2017. The Ministry of Finance released an updated plan April 29 on the subsidies available to buyers of all-electric, hybrid and fuel-cell passenger vehicles, taxis and buses.

In 2016, the government will offer significant subsidies—as previously planned—to help spur purchases of clean vehicles in one of the new strategic industries the country is targeting for development. But starting in 2017, subsidies will be decreased by an average of 20 percent from the 2016 levels. In 2019, they will be cut to 40 percent less than the 2016 subsidies, according to the April 29 announcement.

The ministry had always planned to reduce the subsidies, but the reductions are twice as steep as what the ministry had previously announced. Last December, the government said it anticipated a 10 percent reduction in the subsidies in 2018, and a 20 percent reduction in 2019.

While China is implementing a series of aggressive anti-pollution measures and taking steps to cut greenhouse gas emissions across industries, the country also is attempting, where possible, to let market forces work.

The China Automobile Industry Association data showed March sales of all-electric, hybrid and fuel-cell passenger cars were three times greater than the same month in 2013, with 14,100 vehicles sold last month.

The April 29 announcement “will force carmakers to speed up product development and make their electric cars and hybrids cheap enough to lure consumers even without government's financial help,” Song Yang, an analyst with Barclays Plc, told Bloomberg News.

In 2016, subsidies will vary widely. For instance, an all-electric passenger vehicle able to travel more than 250 kilometers on a single charge will be eligible for the highest subsidy of 55,000 yuan ($8,870). Buyers of new electric cars that can travel between 100 and 150 kilometers on a single charge can get 25,000 yuan ($4,030) off the purchase price.

Plug-in hybrid passenger vehicles with a range of more than 50 kilometers before they switch to a fossil-fuel source are eligible for a subsidy of 30,000 yuan ($4,800).

The plan also greatly supports purchases of fuel-efficient buses. All-electric buses traveling 250 kilometers or more on a single charge can receive 500,000 yuan ($80,600). A plug-in hybrid bus with a range of more than 150 kilometers before switching to a fossil-fuel source is eligible for 250,000 yuan ($40,300).

A fuel-cell passenger vehicle of any range is allowed a 200,000 yuan ($32,200) subsidy; small passenger buses and trucks with fuel-cells get a 300,000 yuan ($48,400) subsidy; and mid-to-large buses and medium or heavy trucks operating on fuel-cell technology can get a 500,000 yuan ($80,600) subsidy.

54. China's Shift to Consumer-Led Growth Drives Jump in Gasoline Demand

China's shift to consumer-led growth is accelerating demand for gasoline in the world's biggest energy user, with the fuel on track to challenge the dominance of diesel as an increasing number of middle class consumers buy bigger family cars.

Diesel production is still forecast to be some 14 percent higher than gasoline this year, but the gap is on course to halve in five years and then disappear in the next decade, according to calculations based on data from consultancy Wood Mackenzie.

The importance of diesel and gasoline varies globally, largely due to the usage in cars and industry. Most cars in China use gasoline, a similar picture to North America where almost 90 percent of private vehicles run on gasoline, while in Europe more than half of new cars are diesel powered.

The relative change in the fortunes of diesel and gasoline in China will require billions of dollars to be invested in new refineries or conversions to meet the shift in demand.

"The gap between these two fuels in terms of their volumes will be narrowed further, since gasoline will likely grow at a faster pace than diesel over the next five to 10 years," said Wood Mackenzie's principal China downstream consultant Fu Feng, highlighting a shift away from investment-led growth.

Chinese investment growth fell to the lowest in nearly 15 years, data in April showed.

A drop in investment in smokestack industries that policy makers are encouraging will impact diesel demand most as trucks, machinery and heavy equipment are all big users of the fuel.

While slower economic growth is hitting overall car sales, gasoline demand has benefited from faster sales of sport utility vehicles with bigger engines that consume more fuel. Retail sales of SUVs soared more than a third last year to 3.82 million, and have more than doubled since 2012, according to the China Passenger Car Association (CPCA).

China's gasoline demand is expected to grow by 8 percent in 2015, compared with growth of less than 1 percent for diesel, Wood Mackenzie's Feng said. For 2016 to 2020, annual demand growth for gasoline is seen at 5.5 percent, versus 1.7 percent for diesel, he said.

Chinese refiners, which just four years ago were scrambling to crank up diesel output to ease shortages, had to change tack in 2014 by expanding gasoline output at the expense of diesel.

About 35 percent, or 3.6 million barrels per day (bpd), of the output of refineries in China is now diesel, down from 45 percent a few years ago, according to refining sources. On the other hand, gasoline output is now 2.7 million bpd, or 26.3 percent of total output, up from 22.3 percent in 2012, separate data from Wood Mackenzie showed. The consulting firm said gasoline supplies will rise on average by about 160,000 bpd a year for the next five years, while diesel is forecast to increase 90,000 bpd,

China plans to invest in gasoline-producing residue fluid catalytic crackers with a capacity of 450,000 bpd in the next five years, Wood Mackenzie said.

55. Air Quality Improved In Beijing Ahead Of Olympic Vote

Beijing Municipal Environmental Protection Bureau (BMEPB) has announced that thanks to the capital's continuous air pollution control efforts and favorable weather conditions, Beijing's air quality has been much improved in the last four months, with the average density of PM 2.5 (airborne particles smaller than 2.5 microns in diameter) dropping by 19 percent compared with the same period last year.

The average densities of sulfur dioxide, nitrogen dioxide and PM 10 also dropped by 43.1 percent, 13.7 percent and 12.3 percent respectively.

According to BMEPB, Beijing's neighboring city Zhangjiakou has the best air quality among over 70 cities in China. Beijing is pursuing a joint bid with Zhangjiakou for the 2022 Olympic Winter Games.

Beijing has renewed its fights against pollution, which include closing a series of coal power plants to bring back "APEC Blue" -- a phrase coined by Chinese netizens to describe the city's clear skies during the Asia-Pacific Economic Cooperation (APEC) meetings in November, 2014.

The International Olympic Committee will vote on Beijing's bid race against Almaty, Kazakhstan, on July 31 in Kuala Lumpur.

Chinese officials say a remarkable improvement in Beijing's air quality is due to good policy. Fang Li, the deputy director of Beijing's environmental protection bureau, said much had been done to address the problem over the last year. "Over the past 12 months our efforts to clean up have actually been greater than at any time before," he told journalists at Beijing's air quality measuring center.

Mr. Li said 476,000 older cars were denied registration last year, with hundreds of thousands more to come off the road. Petrol quality has also been improved, he said, and larger polluting factories have been moved further away from Beijing — potentially to become somebody else's problem.

Recent weather has also seen wind hitting the inland metropolis, blowing away some of the harmful airborne particulates.

Zhang Wangcai, the deputy director of Beijing's department of energy, said Beijing is moving away from coal for electricity generation. Two coal-fired power plants have been closed recently, and a new gas-powered plant has opened up. Mr. Wangcai said no more coal-fired electricity will be produced in Beijing by the end of 2016. "If we're talking about Beijing, by next year all our local power plants will be using clean energy," he said.

56. Hong Kong to Implement New Low Sulfur Fuel Regulation

The Hong Kong Marine Department is implementing a new low-sulfur regulation for ocean-going vessels (OGVs) moored or anchored at a berth in Hong Kong waters from July 1, 2015. The "Air Pollution Control (Ocean Going Vessels) (Fuel at Berth) Regulation (Cap. 311AA)" requires OGVs to use "compliant" fuels while at berth in Hong Kong, when operating main engines (except when used for the propulsion of the vessel), auxiliary engines, boilers or generators. The requirement does not apply during the first hour after arrival and the last hour before departure.

Under the regulation, compliant fuel means low-sulfur fuel with a sulfur content not exceeding 0.5% by weight; liquefied natural gas (LNG); or any other fuel approved by the Hong Kong authority.

Masters are required to record the date and time of fuel switching and keep the records for three years. If an OGV uses technology that can achieve the same or less SO_2 emissions as can be achieved with compliant fuel, the OGV may be exempt from fuel switching.

After the Regulation enters into force on July 1, 2015, masters and owners of any OGVs using non-compliant fuel while at berth in Hong Kong may be liable to a maximum fine of $200,000 and imprisonment for six months. Masters and owners who fail to keep the required records may also be liable to a maximum fine of $50,000 and imprisonment for three months.

57. Hong Kong Vehicle Emission Test Fee to Be Increased

On May 15th, the Government published in the Gazette the Road Traffic Ordinance (Amendment of Schedule 10) Order 2015 proposing to increase the fee to be charged by a designated vehicle emission testing center (DVETC) for testing emissions of vehicles. Under section 77B of the Road Traffic Ordinance (Cap 374), the Commissioner for Transport may, for the purpose of ascertaining whether a motor vehicle complies with vehicle emission standards, require the registered owner to have the motor vehicle tested at a DVETC. The vehicle owner who uses the vehicle emission testing services shall pay to the DVETC a fee that is specified in Schedule 10 to the Ordinance.

A Government spokesman said that the current emission test fee of $310 was set on a full cost recovery basis in 1998 and has not been revised since then. The increase in the test fee reflects the prevailing costs for serving different types of vehicle. Details of the revised fees are set out in the Annex. The fee increase would not affect vehicle owners who properly maintain their vehicles.

As for those who overlook vehicle maintenance and are subject to this emission test, the proposed increase could be a deterrent to negligence.

The amendment order will be tabled at the Legislative Council on May 20 for negative vetting. The proposed new fees are scheduled to take effect on August 1.

58. Air Bubble Shield That Filters Dangerous Particulate Matter to Be Tested in Beijing

A contraption that creates a kind of air bubble that could shield people against as much as 70 percent of the most harmful pollutants debuts next month in Beijing, as China's capital battles the toxic smog that often enshrouds the city.

The outdoor air purifier has a canopy and creates an area protected by an air curtain that attempts to cover around 20 people, lead inventor Jimmy Tong said May 13 in Hong Kong. It was designed by London-based engineering firm Arup Group Ltd. and a unit of Hong Kong property-developer Sino Group.

Beijing's leaders said earlier this year that they will spend 10.8 billion yuan ($1.74 billion) to fight air pollution after the city missed its target in 2014 to reduce the smog. Public concern exploded in 2013 as Beijing's levels of PM-2.5, the tiny particles posing the greatest risk to human health, peaked at 35 times the World Health Organization's recommended limit. The city's air was stuck at hazardous levels again for a week in early 2014.

The technology and prototype of the air purifier was developed for around HK$600,000 ($77,391). It is expected to be used in Beijing's Tsinghua University starting in June. The partners have fielded queries from owners of commercial buildings and Chinese officials, who are interested in having the technology retrofitted onto building canopies and facades, Tong said.

An engineer with a doctorate degree in fluid dynamics from the University of Minnesota, Tong, 38, has experience in designing wind turbines and a rocket launcher.

Testing on the new outdoor air purifier began on Hong Kong's busy Queen's Road East in March, and indicated a 30 percent to 70 percent reduction of PM-2.5 for users standing under the unit's canopy, which had been erected at the front of one of Sino's new residential developments. The partners have applied for a patent for their machine.

Under the canopy, air is filtered in the same way it would be by indoor air purifiers. The machine doesn't clean out nitrogen dioxide, a common roadside pollutant. Tong says he first wanted to filter out the most pressing problem: particulate matter. He says he is looking at applying different filters to eventually help the machine sift out other hazardous substances.

Sino Group in an e-mail said its corporate social responsibility arm is focused on the project and doesn't have plans to commercialize it as yet. The company is working on a cost-effective way to scale up production in case of demand from government bodies.

Across the world, various methods are used to filter dirty air. Some cities plant trees in heavily polluted areas. The University of Engineering & Technology in Peru put up a billboard that filters air in the middle of a Lima construction site; while a jumbo air freshener was installed in the center of New Delhi a few years ago.

“We would of course welcome any new technology that decreases human exposure to pollutants,” said Sum-yin Kwong, chief executive officer of Hong Kong-based advocacy group Clean Air Network. “But at the end of the day, the only way we can be safe is to stop the hazardous particles from filling the air in the first place.”

59. China Turns Focus to Smoky Ships, Boats in Fight against Pollution

China is considering regulating emissions from boats and ships, the environment ministry said, as it tries to clamp down on pollution. The Ministry of Environmental Protection said it was seeking public feedback on whether to pass the regulation, which could include an IMO Emissions Control Area (ECA) to be established along China’s 14,500 km coastline and include new standards for marine fuel quality.

"Environmental pollution problems caused by shipping are becoming more evident," Xiong Yuehui, an official with the ministry, said in a statement on the ministry's website, adding that China had 172,600 vessels at the end of 2013. He estimated that the shipping sector accounted for 8.4 percent of China's sulfur dioxide emissions and 11.3 percent of nitrogen oxide emissions in 2013.

Environmental regulations for ships are overseen globally by the International Maritime Organization. But while the IMO has cut pollution with emissions controls in America and Europe, which use low-sulfur marine fuels as standard, Asia has been left untouched with the upcoming July 1, 2015 at berth low-sulfur regulation in Hong Kong marking the first port in the region to take such action.

Last October, a U.S. environmental group said shipping was a significant source of air pollution in China and that one container ship along the country's coast emitted as much diesel pollution as 500,000 Chinese trucks a day.

Beijing has previously promised tax cuts to ships that cause less pollution, but Yuehui is understood to be the first government official to openly discuss the possibility of an ECA being established. As eight of the top ten busiest container ports are in China, which now also has over 70 percent of the global seaborne iron ore trade and a substantial portion of seaborne oil trades, a Chinese ECA would have far reaching implications for vessel operators.

Earlier Hong Kong's under-secretary for the environment Christine Loh said China's increasing interest in improving the country's air quality meant a potential Pearl River Delta (PRD) ECA has a high chance of success. According to Loh, China's government has taken heavy interest in improving the country's air quality, though she admits that the plans could take some years to come to fruition. "You [in California and Europe] are the ones with the Emission Control Areas (ECAs) and the Sulfur Emission Control Areas (SECAs)," Loh said. "We want that too."

The PRD area, which includes the ports of Hong Kong, Guangzhou and Shenzen, reportedly accounts for 12 percent of all goods shipped worldwide. "Our longer-term aim, hopefully in a few years, is to make the whole PRD area an ECA," she said.

Starting July 1, new sulfur regulations in Hong Kong are set to begin limiting sulfur content in marine fuel for berthed ocean-going vessels (OGV) to 0.5 percent. (See story below.)

60. China's Draft Standards Would Regulate Airborne Emissions from Inland Boat Engines

China's Ministry of Environmental Protection released draft standards that for the first time would regulate emissions from boats on the country's rivers and lakes. The regulations would require all boats or boat engines sold after Jan. 1, 2017, to limit emissions of carbon monoxide, hydrocarbons, nitrogen oxide and particulate matter. After three years, the limits would be tightened again for hydrocarbons, nitrogen oxide and particulate matter.

The government also said it could begin regulating the sulfur content in diesel fuel used by inland boats by mid-2018.[3] Standards for gasoline-powered boats could follow, the Ministry of Environmental Protection said.

The MEP released draft standards June 4 for engines in domestic marine vessels such as river boats, tugboats and ferries that it expects could reduce air pollution near riverside and coastal areas. The standards would cover diesel motors with a rated power of 37 kilowatts or above for inland and coastal vessels, but would not apply to ocean-going vessels. A first draft of the standards was released last July. The draft released June 4 could undergo additional changes.

Environmental officials also are updating wastewater and solid waste discharge standards for ships in China's waters, and will be formulating emissions standards for the shipbuilding industry, primarily to control volatile organic compound emissions, the MEP said June 8 in an explanatory document.

Officials are studying emissions data from the Yangtze River Delta near Shanghai and the Pearl River Delta in Guangdong province and could recommend more policies to cut emissions by year's end, according to a document released internally by the China Maritime Safety Administration. Currently, only port areas in Shenzhen in southern China and Hong Kong are

[3] According to a draft amendment to the Air Pollution Law, tabled to the National People's Congress (NPC) Standing Committee for a second reading in June, ships on inland or river-to-sea waterways must use standard diesel as fuel to cut emissions. Sulfur levels in standard diesel are to be limited to a maximum of 10 ppm by 2018 across the entire country.

experimenting with emissions control for oceangoing vessels. In Shenzhen, which started piloting policies to encourage a switch to lower sulfur bunker fuels at berth late last year, the process has been slow to take hold.

61. Hong Kong Incentives Would Spur Ships to Adopt Use of Low-Sulfur Fuels in Port

Hong Kong, the world's fourth-largest container port by volume, is extending financial incentives to get ocean-going ships to switch to low-sulfur fuels while in the special administrative region's waters. Under rules finalized in April, ships berthing in Hong Kong must use fuel with a sulfur content of 0.5 percent or below as of July 1 or face potential fines of up to $25,000.

But a new policy announced June 1 by Hong Kong's Environmental Protection Department would let some ships offset the costs of switching fuel by halving other port facility fees. It is part of an effort to reduce persistent air pollution near heavily populated areas along the port areas of Hong Kong.

The incentive program actually started in 2012, and was set to expire in September. The June 1 announcement extends the program for 30 months and coincides with the first 2 1/2 years of the required low-sulfur-fuel-use period.

Incentives also will be available for the first time for vessels that use liquefied natural gas or other approved fuels and technologies that reduce sulfur dioxide emissions, according to the statement.

Around 40 percent of the sulfur dioxide emissions in Hong Kong comes from ocean-going vessels, but total sulfur dioxide emissions could be cut by 12 percent if the fuel-switching is adhered to, the Environmental Protection Department said.

Mainland neighbor Shenzhen also is giving incentives to ships to switch to 0.5 percent sulfur fuels at its ports.

62. Beijing-Tianjin-Hebei Rolls Out Measures to Tackle Air Pollution

Beijing and Tianjin will give financial and technological support to four cities in Hebei province to help them tackle air pollution. In addition, the six cities are to build a unified emergency response system to cope with heavy smog.

Beijing will join forces with its two southern neighbors, Langfang and Baoding, while Tianjin will work with the neighboring port cities of Tangshan and Cangzhou, the Beijing Environmental Protection Bureau said.

The cities in Hebei will receive special funds and advanced technology from the two municipalities.

All six cities, which form the core area for regional efforts to control air pollution, are to build a unified system to forecast heavy smog and implement emergency response measures. The project will draw on the experience gained from the coordinated efforts made during the Asia-Pacific Economic Cooperation meetings in Beijing in November, the capital's environmental bureau said. The cities currently have their own emergency systems and impose different restrictions on the use of vehicles on smoggy days.

During the APEC meetings, the governments of Beijing and Tianjin, the provinces of Hebei, Shandong, Shanxi and the Inner Mongolia autonomous region jointly adopted tough measures to improve air quality. Work at more than 14,000 factories in polluting industries and 40,000 construction sites was suspended.

Their efforts meant that residents saw a clear improvement as the concentration of PM2.5— airborne particles measuring 2.5 micrometers or less that can penetrate the lungs and harm health was reduced by 30 percent in Beijing, Fang Li, deputy head of the bureau, said in November.

The coordinated efforts by the six core cities are expected to reduce air pollution in a similar way, the bureau said.

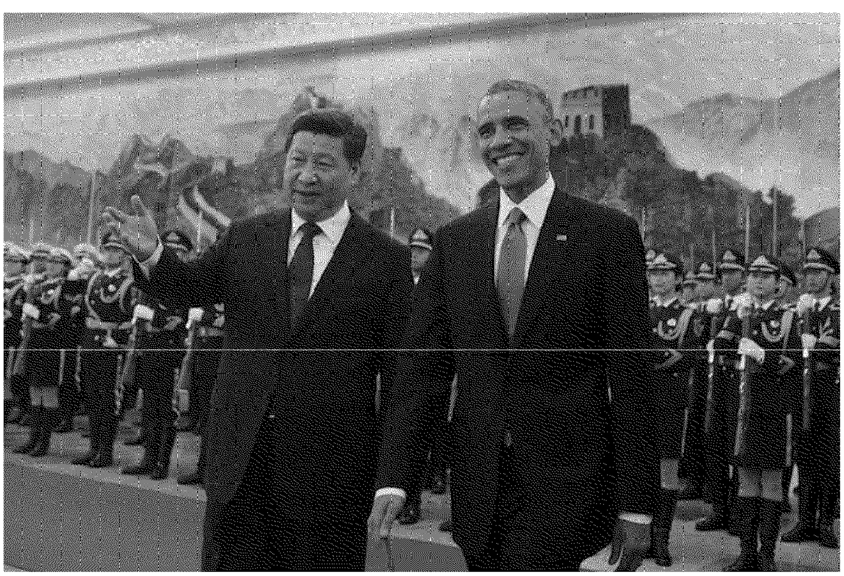
Officials set out a number of major areas in which action will be taken this year — cutting vehicle exhaust emissions and coal consumption, reducing the amount of straw that is burned by farmers, phasing out industrial overcapacity, lowering emissions of volatile organic compounds and reducing pollution at ports.

Seven of the 10 Chinese cities with the worst air pollution are in Hebei, but the province is making efforts to take at least Langfang off the list this year, the provincial Environmental Protection Bureau said.

Beijing needs to control the amount of pollutants blown in from other areas, since they are a major cause of smog in the capital, according to Ma Zhong, dean of Renmin University of China's School of Environment. Research by the Beijing environmental bureau found that 28 to 36 percent of PM2.5 in the atmosphere over the capital comes from surrounding areas, including Hebei. Beijing should compensate Hebei for the economic losses caused by closures of factories that cause pollution and the introduction of more advanced technology, Ma said.

In addition, the governments need to unify standards on pollutant emissions, fuel quality and sewage discharges.

63. Study Says China Can Stop Catastrophic Climate Change. But Will It?



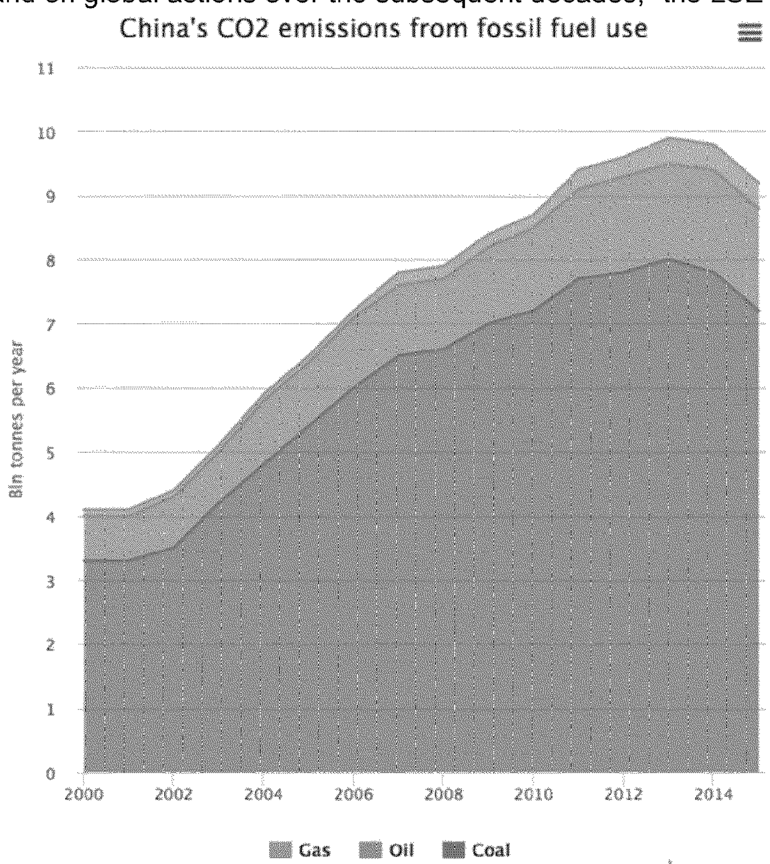
CREDIT: AP Photo / Andy Wong

A new study[4] confirms what has been increasingly clear to outside observers: Whether or not the world will avert catastrophic climate change is now, to a large extent, in the hands of the Chinese.

The New London School of Economics (LSE) study was written by analyst Fergus Green and climate economist Nicholas Stern and notes that China's coal use appears to have peaked. And that means China's CO2 will likely peak by 2025 — five years earlier than the public commitment the country made to the world as part of the climate deal with the United States last year.

The world needs to slash greenhouse gas emissions roughly in half by 2050 and then drop to zero emissions or below by 2100 to have a reasonable chance of stabilizing below 2°C — the level that the world's leading scientists and governments have determined is a threshold beyond which dangerous climate impacts accumulate and accelerate rapidly.

"Whether the world can get onto that [2°C] pathway in the decade or more after 2020 depends in significant part on China's ability to reduce its emissions at a rapid rate, post-peak (as opposed to emissions plateauing for a long time), on the actions of other countries in the next two decades, and on global actions over the subsequent decades," the LSE paper explains.



China's coal use (dark orange) has dropped sharply since 2013, according to government data analyzed by Energydesk China.

Speeding up climate action outside of China remains vital. All efforts must be taken to preserve, meet, and even beat the CO2 commitments that countries have made — and to mobilize for even deeper cuts in the future. But the stranglehold the anti-science and pro-pollution crowd have on Congress limits the US near-term flexibility to act and lead. And the EU is already committed to cut total emissions 40 percent below 1990 levels by 2030, and will no doubt make stronger commitments in the future.

But China has publicly committed only to peak CO2 emissions by 2030 or earlier, to peak coal use by 2020, and to double its share of carbon-free power by 2030. When the peaks occur and

[4] *China's "new normal": structural change, better growth, and peak emissions* from LSE's Grantham Research Institute on Climate Change and the Environment and its Center for Climate Change Economics and Policy.

whether they look more like plateaus or actual peaks will determine whether we have a serious chance at avoiding climate catastrophe. That said, the Chinese agreed in the pledge “to make best efforts to peak early” — which strongly suggests they always anticipated peaking earlier.

According to the report’s authors, “to reduce its emissions at a rapid rate, post-peak, China will need to deepen its planned reforms in cities and in the energy system, supported by a concerted approach to clean innovation, green finance and fiscal reforms.”

In the report, authors Stern and Green include a scenario whereby CO2 emissions from energy could peak as early as 2020. They argue that a China CO2 peak between 2020 and 2025 could allow the world to put global greenhouse gas emissions on the 2°C pathway.

64. China Pledges to Cut the Carbon Intensity of Its Economy Up to 65 Percent by 2030

China promised to further decarbonize its economy as part of its national commitment toward a global climate deal submitted to the United Nations June 30. The world's top emitter and second-biggest economy pledged to cut its carbon emissions per unit of economic output 60 percent to 65 percent by 2030 from 2005 levels. It already has cut the carbon intensity of its economy by about 34 percent.

Chinese Premier Li Keqiang unveiled the pledge at a meeting with French President François Hollande in Paris where nearly 200 countries will gather later this year in hopes of signing a global accord that would for the first time commit both developed and developing nations to act on climate change.

“As a developing country with a population of more than 1.3 billion, China is among those countries that are most severely affected by the adverse impacts of climate change,” its pledge said.

The country's rapid industrialization and urbanization have made its greenhouse gas emissions climb significantly during the past decade or so, now accounting for about a quarter of the world's total emissions.

The carbon intensity goal builds on China's earlier pledge to peak its overall greenhouse gas emissions by 2030 or sooner, which many hailed as ground-breaking when it was announced in November 2014.

If China hits the higher end of the new intensity goal, it could mean deeper cuts on an annual basis than China's current carbon intensity target—a 40 percent to 45 percent reduction by 2020 from 2005 levels—according to an analysis by Greenpeace. China first pledged to cut its carbon intensity in the run-up to the 2009 climate summit in Copenhagen.

The new target should help China to peak its carbon emissions earlier and lower than previous estimates, the Natural Resources Defense Council said in its take on the pledge.

China also reiterated its goal to expand the share of non-fossil fuels, including renewables and nuclear power, in its energy mix to “around” 20 percent. Doing so would require curbing its coal consumption, which fell in 2014 for the first time in at least a decade (.

The pledge maintained China's stance that any commitments it makes will "match its national circumstances, current development stage and actual capabilities."

UN Secretary-General Ban Ki-moon told those attending the one-day UN climate event that the world's "journey toward bold climate action is at a critical moment. The stars have aligned as never before—the world's biggest emitters of greenhouse gas emissions have announced ambitious climate actions and are showing leadership based on mutual respect and collaboration." But Ban warned that there has been too little progress so far on the global accord as negotiating time runs out.

Aside from China, the U.S. and the EU, about a dozen other countries have filed their formal submissions to the UN, known as Intended Nationally Determined Contributions (INDCs), which will serve as building blocks of the global agreement. In a pledge submitted the same day as China's, South Korea said it plans to cut its emissions 37 percent throughout a business-as-usual scenario by 2030. Serbia and Iceland also filed their submissions, according to the UN website that tracks them.

Other major emitters, such as India, Indonesia and Brazil, have yet to submit their climate plans.

The climate accord did come up, however, during a June 30 meeting between Brazilian President Dilma Rousseff and U.S. President Barack Obama, in which the two said they would work "to resolve potential obstacles towards an ambitious and balanced Paris agreement" (see related story).

"Countries accounting for nearly 70 percent of current global energy carbon-dioxide emissions have already announced and are taking action on post-2020 climate policies," Brian Deese, one of Obama's top climate advisers, said in a statement, adding that the U.S. "encourages all major economies to submit their INDCs as soon as possible" to ensure a successful outcome at the Paris talks.

65. China Puts $6 Trillion Price Tag on Its Climate Plan

It will cost China over $6.6 trillion (41 trillion yuan) to meet the greenhouse gas reduction goals it will lay out later this month in its strategy for United Nations climate negotiations, the country's lead negotiator for the talks recently announced. Xie Zhenhua, special representative for climate change affairs at China's National Development and Reform Commission, said the objectives China will outline by the end of June will be "quite ambitious".

Xie was participating in a three-day Strategic and Economic Dialogue forum in Washington where he met with counterparts in the Obama administration, including U.S. climate negotiator Todd Stern, Environmental Protection Agency Administrator Gina McCarthy and Energy Secretary Ernest Moniz.

To meet its objectives, China, the world's biggest greenhouse gas emitter, must reconfigure its coal-dependent energy mix and develop new energy sources, Xie said. "We will need to carry out international cooperation and research and development to reduce the costs of relevant technologies and to innovate so that we can reach our objectives," he told reporters at a State Department briefing.

The United States and China also announced they will partner on two new carbon-capture, utilization and storage projects to help commercialize the technology.

While key details of China's plan are not yet known, it is expected to include targets announced in November, when it reached a key climate change deal with Washington to cap its emissions by 2030 and fill 20 percent of its energy needs from zero-carbon sources.

Earlier this month, Chinese Premier Li Keqiang reaffirmed the government's commitment to hit a carbon emissions peak by "around 2030". The country's coal consumption decreased for the first time in years in 2014, however, leading some to speculate that its emissions could reach their peak sooner.

Stern, the U.S. climate change envoy, told reporters the plans China has already announced with Washington were "a quite strong contribution". But he said he hopes a final agreement of all countries at this December's key UN climate change conference in Paris contains "a strong set of contributions, which are updated periodically" to ensure more ambitious targets. Stern said China does not expect public finance to support its climate goals and that it is likely to attract investment as it adopts new technologies.

Earlier, Chinese Vice Premier Wang Yang told a panel moderated by former U.S. Treasury Secretary Hank Paulson that 750,000 electric vehicles were sold in China last year, three times more than the year before, "giving great opportunities and profit to companies like Tesla and BYD (Auto) "."To tackle climate change is both a challenge and an opportunity," Wang said.

Ahead of the UN's climate change conference in Paris, countries are required to submit national plans, which will serve as the building blocks of a final agreement. So far, 11 countries, including the United States and Mexico, as well as the European Union have submitted theirs.

66. U.S.-China Strategic & Economic Dialogue Outcomes of the Strategic Track

At the seventh round of the U.S.-China Strategic and Economic Dialogue (S&ED) June 22-24, 2015, in Washington, D.C., Secretary of State John Kerry, special representative of President Barack Obama, and State Councilor Yang Jiechi, special representative of President Xi Jinping, chaired the Strategic Track, which included participation from senior officials from across the two governments. The two sides held in-depth discussions on major bilateral, regional, and global issues. The dialogue on the Strategic Track produced the following specific outcomes and areas for further cooperation:

44. CCWG Heavy-Duty and Other Vehicles: With the support of numerous technical and policy exchanges under the Climate Change Working Group, the two sides made significant domestic policy and programmatic progress in the key working areas of the Heavy-Duty and Other Vehicles initiative. On fuel consumption and greenhouse gas emission standards, the United States is currently developing new greenhouse gas emissions and fuel economy standards for medium- and heavy-duty vehicles for post-2018 model years. These standards were proposed in June 2015, and are to be finalized by the end of 2016. China is developing new fuel consumption standards for light- and heavy-duty commercial vehicles for 2020 model years and thereafter, to be finalized by the end of 2015 and the end of 2016 respectively. On tailpipe emissions and fuel quality standards, China has accelerated its schedule to implement ultra-low sulfur gasoline and diesel fuel nationwide one year, to the end of 2016. To take advantage of high quality fuel availability, China is currently developing the China 6/VI emission standards for light- and heavy-duty vehicles, to be finalized by the end of 2017. China has additionally established an improved compliance program for heavy- and light-duty vehicles in 2015. On green freight, the United States has expanded the SmartWay Program to include barge freight in the United States starting in 2015, and is to add air freight in 2016. China has enhanced the Green Freight Initiative to include green freight efficiency standards, a 20 company pilot project, and green driving pocket book. Finally, the two sides decided to launch a new U.S.-China Race to Zero Emissions bus initiative to commence in fall 2015.

45. Electric Vehicles Workshop: In support of U.S.-China cooperation on electric vehicles and the U.S.-China Innovation Dialogue, the U.S. Trade & Development Agency and the Ministry of Science and Technology of China co-hosted an Electric Vehicles Workshop to engage public and private sector representatives in discussions on standards and technology in June 2015.

Cooperation on Environmental Protection

69. Air Quality: The U.S. Environmental Protection Agency (EPA) and the Ministry of Environmental Protection of China (MEP) collaborated on a range of air quality issues and advanced capacity on regional air quality planning; pollution prevention and multi-pollutant control of emissions from refineries, cement, petrochemical, coal-fired power, iron and steel; emissions from vehicles and vessels; and mercury emissions controls. EPA and MEP are discussing hosting the 2015 Regional Air Quality Management Conference on volatile organic compounds; a workshop on outcomes/lessons learned from the Jiangsu Province project for Chinese provinces and cities; sharing best practices on mercury emissions; and **promoting implementation of the action plan for heavy-duty diesel vehicles, including ultra-low sulfur fuel, advanced emission and fuel efficiency standards, strong compliance programs, and green freight programs.**

70. Exchanging Ideas to Combat Air Pollution: In order to share best practices on solutions to combat air pollution and further support the regional air emission technical assistance program supported by the United States Trade & Development Agency (USTDA) and the Ministry of Environmental Protection (MEP), USTDA and MEP decided to bring representatives from Jiangsu's Environmental Protection Bureau on a study tour in fall 2015 to showcase U.S. technologies and best practices in air quality management.

71. Low NOx Boiler Emission Reduction Feasibility Study and Pilot Project: The United States Trade & Development Agency and the Beijing Environmental Protection Bureau decided to work together to conduct a feasibility study and pilot project to demonstrate low nitrogen oxides (NOx) burner technologies to meet stricter NOx emission requirements for gas-fired boilers in Beijing.

75. Enforcement of Environmental Laws: The U.S. Environmental Protection Agency (EPA) and the Ministry of Environmental Protection of China continued to advance best practices in environmental compliance and enforcement with national, provincial, and municipal officials. The two sides held high-level discussions on new technologies/approaches and next generation compliance and enforcement; oversight of local enforcement; and implementation of penalty authorities under China's Environmental Framework Law. The two sides are exploring a potential visit to China by the EPA Assistant Administrator for Enforcement and Compliance Assurance in advance of the Joint Committee on Environmental Cooperation to focus on next generation compliance and enforcement, participation in the International Network for Environmental Compliance and Enforcement workshop on air enforcement and climate change.

76. Environmental Laws and Institutions: The U.S. Environmental Protection Agency (EPA) and the Ministry of Environmental Protection of China (MEP) shared information and best practices on revisions to China's framework Environmental Protection and Air Pollution

Prevention and Control Laws and supporting regulations. China's 2014 revisions to its Environmental Protection Law include provisions discussed by the two sides, such as authorities for environmental public interest litigation, public disclosure of pollutant discharges, suspension of new pollution source approvals in non-attainment areas, and enhanced penalties for violations, such as daily penalty, detention and criminal penalty. EPA hosted officials from China's Supreme People's Court on legal experience and approaches to water protection and pollution control. EPA and MEP intend to continue collaboration on environmental law and adjudication, regional air quality planning and pollution control, and pollutant permitting. Experience has proved that the professional communication between MEP and EPA has promoted the progress of environmental laws and adjudication.

77. Environment and Development: The U.S. Environmental Protection Agency and the Ministry of Environmental Protection of China supported and attended the China Council for International Cooperation on Environment and Development (CCICED) Environment and Development Think Tank Symposium June 22, 2015 in Washington, D.C. **The symposium was held to support the development of CCICED as a new type of think tank and promote experience sharing on environment and development.** Think tanks and research institutes from the United States and China participated in the symposium and discussed the functions, operational models and development trends of think tanks, and how to strengthen cooperation to promote the realization of post-2015 sustainable development goals.

67. China's Air Quality Shows Signs of Improvement: Environmental Minister

Environmental Minister Chen Jining revealed to the country's legislators that China's air quality has shown consistent improvements in 2014 and thus far in the first four months of this year. According to Xinhua, Chen said that PM10 readings reduced by more than two percent in over 300 cities across the country last year. In the first four months of 2015, PM10 readings from these cities continued to drop by more than five percent. Also, in 74 cities, PM2.5 readings reduced by 11 percent in 2014 and over 15 percent in the first four months of this year.

Authorities have taken a direct approach to combat pollution by developing regulations to control the activities of individuals and companies in sectors that contribute to the country's air pollution. Among other things, authorities have sought to promote 'green' renewable energy and reduce the country's use of coal, regulate emissions in industries as well as in the shipping sector and level greater punishments on individuals and companies responsible for polluting the atmosphere.

According to Chen, strict implementation of the country's environmental policies has contributed to the successful reduction of pollutants in the atmosphere. He revealed that last year, more than 8,000 suspects were apprehended by the police for environment-related crimes. (See story below.)

Chen explained that support and coordination between government agencies and the adoption of the latest technology have also contributed to the reduction of pollutants in the atmosphere. He added that the country will impose stricter regulations on the coal industry, improve technological research as well as the measurement of pollutants in the air and impose heavier penalties on wrongdoers.

68. Minister Chen: China Arrested Over 8,000 People for Environmental Crimes Last Year

More than 8,000 people were arrested in China for violating environmental laws last year, in what officials said was a sign of the country's determination to enforce its laws more strictly, in the face of grave pollution. Chen Jining, China's recently appointed Minister of Environmental Protection and former Tsinghua University president and environmental scientist, told a meeting of the country's legislature that some 8,400 people were detained in 2014 -- while more than 2,000 cases of environmental violations were handed over to police, twice as many as in the previous decade.

The announcement comes amid growing public concern about environmental pollution in China. The director of China's National Development and Reform Commission said recently that natural resources and the environment were among the biggest obstacles hindering China's drive to become a "moderately prosperous society."

Chen told the legislature that enforcing environmental laws more strictly was key to curbing air pollution, according to the Xinhua news agency. He said that inspections on the ground, and some using drones, had led to the closure of more than 3,000 companies, a similar number of small factories, and 3,700 construction sites in 2014.

Chen added that aside from some $4.1 billion that the government spent on pollution prevention last year, private investment worth 300 billion yuan ($48 billion) also went into the sector. He also said that China planned to reduce the levels of sulfur dioxide and nitrogen oxide in the air by 3 percent and 5 percent respectively this year.

Earlier this year, China passed a new environmental law, with stricter fines for polluters -- and the past few months have already seen record fines for a number of polluting businesses, including a state petroleum giant and a factory supplying food to McDonald's restaurants in Beijing.

The government has also pledged to spend billions to clean up the country's polluted water resources, and has proposed a new pollution tax that would levy charges on companies that produce not only air and water pollution, but also noise above a certain level.

The authorities have also promised a particular clean-up of the area in and around the capital city Beijing, which has become notorious for its bad air pollution. The city's mayor recently acknowledged that environmental problems were making Beijing "unlivable" -- but as Beijing and neighboring Hebei province bid to stage the 2022 Winter Olympics, steps are being taken to improve air quality; one major power plant in the center of the city was closed down in April.

Environment minister Chen said that official measures were having some impact, with pollution readings down in major cities in the first four months of this year, falling the most in Beijing and the surrounding area (though official readings have often been questioned in the past). Xinhua also reported that China's coal consumption fell last year, for the first time in 15 years, by 2.9 percent, as cleaner energy sources came on-stream. And Chen said 1,000 small coal mines would be closed down this year.

Environmental groups have said that the government does seem to be taking the country's problems increasingly seriously. Yet issues remain deep-rooted: a government-backed magazine recently reported that tens of millions of people are affected by water containing dangerous levels of fluoride and iodine, for example.

And implementation at the local level remains the biggest problem, with local governments often desperate to boost economic growth and cutting corners on the environment to do so, while some major companies have traditionally felt powerful enough at a local level to defy the law. China's state prosecutors recently admitted that not all cases of environmental violations are handed over to prosecutors as they should be, due to protectionism and favoritism.

However China's Supreme People's Procuratorate added that it was launching a campaign to scrutinize law enforcement in such cases, and would also focus on abuses of the environmental impact assessment process. (63 companies involved in risk analysis were recently barred or restricted from bidding for projects after being found to have falsified results.)

And there have been some signs of the Ministry of Environmental Protection cooperating more effectively with other ministries, including the legal authorities: 18 staff of a company that manufactured weed-killer in eastern Zhejiang province were recently jailed, and the company fined around $12 million, for discharging wastewater that severely polluted streams in the area.

And in an attempt to reduce the blind pursuit of economic growth, the government recently said that officials found to have caused environmental damage would be barred from being promoted, and would be "held responsible for their lifetime."

Chen also pledged “more covert inspections” of companies, and heavier penalties for those that “forge pollution data," and stressed that those who neglected their duties or abused their power would be investigated. His comments follow the announcement earlier in June that more than 2,000 officials had been arrested for environmental violations in the previous 16 months.

69. China Enforces Requirements on 17 Companies

Subsidiaries of three of China's largest state-owned power generators were among 17 companies that had excessive emissions of sulfur dioxide and nitrogen last year or failed to have properly operating technology to detect and remove those airborne pollutants, the Ministry of Environmental Protection said.

Subsidiaries of China Datang Corp., China Power Investment Corp. and China Guodian Corp. were among those cited for excessive sulfur dioxide or nitrogen oxide emissions, and with problems at the facilities with desulfurization and denitrification technologies, which remove sulfur dioxide and nitrogen oxide from exhaust flue gases of fossil fuel power plants. Other state-owned companies named included subsidiaries of textile, power and aluminum producer Shandong Weiqiao Pioneering Group Co. Ltd.

The companies must submit upgraded plans to ensure that emissions are under control by the end of 2015, and must pay airborne pollution discharge fees for 2014. In addition, 14 of the companies must return subsidies they received for operation of desulfurization and denitrification technologies, the ministry said.

Sulfur dioxide and nitrogen oxide are the two key air pollutants officially controlled under Chinese regulations. Companies are charged for these emissions above certain thresholds and major emitters are expected to install and operate technology to reduce their release into the atmosphere.

In mid-May, the environment ministry announced that it would launch a special investigation campaign through the end of August to ensure that companies are properly operating desulfurization and denitrification technologies.

70. Former Secretary Paulson Says Pollution Could Overwhelm China as Cities Expand

Former U.S. Treasury Secretary Henry Paulson said China's leaders are serious about tackling environmental problems but could be overwhelmed as hundreds of millions more people flock to cities in coming decades. China's leaders “care about climate change and they understand it and are seriously working on it—that's the good news,” Paulson said June 25 during an event in Seattle. “The bad news is they've taken all kinds of actions, but they've been blown away by the explosive, breakneck growth.”

Paulson has been traveling the globe to promote his latest book, “Dealing With China: An Insider Unmasks the New Economic Superpower.” He has said Asia's largest economy is “running out of steam” and risks a “day of reckoning” if leaders don't adopt a new model for municipal finances.

The book also addresses environmental challenges the country is facing. On June 25, Paulson called China's urbanization policy “broken” because it creates pollution and stress. He estimated that the number of people in cities there could surge by 300 million during the next 25 years from about 650 million now.

“The dirty air is killing people,” Paulson said. China's leaders “don't believe the Communist Party will stay in power unless they make progress” on pollution, he said.

Paulson, 69, was chairman of Goldman Sachs Group Inc. before serving as Treasury secretary under President George W. Bush from 2006 to 2009.

71. China Considers Replacing Problematic Pollution Fee System with Environmental Tax

An environmental tax law expected to replace China's ineffective pollution fee system could help the nation fight severe pollution while bringing more revenue into local government coffers, according to a Chinese tax expert. The draft Environmental Protection Tax Law, released June 10 by the State Council Legislative Affairs Office, would target primarily the most polluting industries. It is available for public comment through July 9.

“One of the main breakthroughs with this law is that the pollution fees, which are currently collected by environmental protection departments, will be managed both by tax authorities and environmental authorities,” Gao Ping, a professor at the School of Taxation of the Central University of Finance & Economics in Beijing, told reporters on June 15.

While the draft law states that the projected tax rate is similar to pollutant discharge fees, Gao said, in reality, it could force polluters to pay more than currently levied under pollutant discharge fee rules, which are applied inconsistently and lack the force of law.

Local-level environmental protection bureaus—which often manage the current fee-based penalty system—are tied directly to local governments and have been accused of helping to protect polluting companies, or of lax enforcement meant to protect the local economy. Under the current system, it is not unusual for pollution fees to be halved for some violators, Gao said.

“The [proposed] law also encourages local governments, which are facing pressure to improve the environment, in places such as Beijing and Tianjin, to increase their tax bases,” Gao said. “These areas have also been increasing their pollutant discharge fees a lot lately.”

Under the proposal, airborne pollutants would be charged 1.2 yuan ($0.19), depending on the unit (per 0.95 kilogram for sulfur dioxide, for example), water pollutants 1.4 yuan ($0.23) a metric ton, with solid wastes including refining waste, coal ash, waste coal, and other liquid and solid wastes charged between 5 to 30 yuan ($0.81 to $4.83) a metric ton, depending on the category.

Industries potentially covered include thermal power, steel, cement, electrolytic aluminum, coal production, metallurgy, building materials production, mining, chemical production, pharmaceutical production, brewing, paper making, fermentation, sugar processing, vegetable oil processing, textiles and leather.

Agricultural production and **pollution from mobile sources such as vehicles, trains, airplanes, ships, railways and off-road mobile vehicles would be exempt from the taxes.** Wastewater treatment plants and incinerators that do not breach their emissions quotas also would be exempt, and companies within the taxed group that emit half the national average could have their taxes reduced by local governments.

Detailed taxes on the most emitted heavy metals and on noise—levied by decibel level—are expected to be announced later.

According to a June 13 report from Economic Information Network, a news organization affiliated with the National Development and Reform Commission, the earliest the draft law would be reviewed by the Standing Committee of the National People's Congress would be at the end of 2015. At that earliest timeline, approval could come in 2016, but official adoption of the tax is not likely until 2017 at the earliest. The report also indicated that the Ministry of Finance has prepared draft implementation guidelines for the law.

72. Delhi Budget Plan Focuses on Improving Public Transport to Address Air Pollution

The government of Delhi wants to cut the number of private vehicles on city roads, provide more public transport and subsidize electric-rickshaws in an effort to reduce air pollution. The proposals are part of its budget plan for the current fiscal year that includes an energy conservation fund, a water treatment plant and a tree planting drive.

Delhi has among the worst air quality in the world, much of it attributed to its high vehicular density and per capita ownership of cars. It also is battling pollution of the Yamuna River and depleting groundwater level and quality.

Because of the makeup of Delhi's government, the budget proposal is almost certain to become law.

The budget proposes to increase the allowance for transportation by nearly a quarter to Rs 5,085 crore ($799 million), which will be used to buy 10,000 buses, set up 1,200 bus stop shelters, and install closed-circuit TV cameras and deploy marshals on state-run buses to ensure the safety of passengers, particularly women. This last measure aims to improve attitudes toward public transport, which worsened considerably after a gang rape in a moving bus in Delhi in December 2012.

The budget also proposes a congestion tax on trucks entering the capital territory, the revenue from which would be used to improve public transport. To improve last-mile connectivity, about

5,500 new auto-rickshaw permits would be issued for the National Capital Region, which includes Delhi, New Delhi, Gurgaon, Noida and other neighboring cities. And a subsidy would be offered on purchase of e-rickshaws.

Other proposals include planting 1.2 million saplings, establishing a fund to finance energy efficiency projects and street lighting, opening a new water treatment plant close to the Yamuna, and refurbishing two existing plants.

The emphasis on the environment in the budget, the first to be presented by the Aam Aadmi Party—a new and small political party that came to power largely on an anti-corruption and anti-incumbency plank—won kudos from environmentalists. Anumita Roychowdhury, executive director at New Delhi-based Centre for Science & Environment, who also heads its air pollution control campaign, told reporters on June 26th that the emphasis on public transport "is a much needed move at a time when Delhi is gasping for breath and the daily travel trips are expected to explode to 25.3 million trips a day. The travel choices of the people will determine the livability of Delhi."

The budget will be voted on in the ongoing session of Delhi Assembly and would come into effect after being passed and approved by the lieutenant governor.

73. South Korea to Adopt New Diesel On-the-Road Emissions Standards in 2017

All new diesel cars and other light-duty diesel-powered vehicles sold in South Korea must meet on-road emissions standards based on real-world driving conditions beginning in September 2017, the Ministry of Environment said. "On-road emissions evaluation will be conducted as an add-on to the existing laboratory testing program," the ministry said in a June 12 statement. "The enforcement of on-road emissions standards will contribute to tighter oversight of compliance with diesel car emissions standards."

On-road emissions are measured by a portable emission measurement system (PEMS) that works while a vehicle is in actual road use, rather than in a laboratory setting. The standards are being developed by South Korea in conjunction with the European Union, which is studying its own on-road testing methods and standards for diesel vehicles.

Testing has found that while laboratory tests closely mirror actual on-the-road emissions from gasoline-powered vehicles, they can significantly understate the real-world emissions from diesel-powered vehicles, the ministry said. For instance, while nitrogen oxides emissions standards for diesel-powered vehicles were made more than 600 percent tougher in 2000, the reduction in actual emissions on the roads was only 40 percent, the ministry said, **citing data from the International Council on Clean Transportation.**

In South Korea, the new tests are needed to give a clearer picture of actual automobile emissions that can be affected by things like outside temperature, road slope variations, driving styles and even air conditioner use, the ministry said.

South Korea's own on-road testing conducted by the Transportation Pollution Research Center shows that Euro V-compliant diesel vehicles (generally built since 2008) emitted between 1.14 times and 9.6 times more nitrogen oxides emissions than legally allowed in real-world driving, while Euro VI-compliant (built since 2014) vehicles exceeded the prescribed standards by 1.25 times to 2.8 times.

South Korea has adopted Euro engine emissions standards since 2005, and Euro VI is currently in force for new diesel passenger and commercial vehicles.

The ministry will develop on-road testing methods and standards for light-duty diesel motor vehicles weighing less than 3.5 tons in 2015 and incorporate new provisions into the Air Quality Preservation Act in 2016, to take effect in 2017.

South Korea's diesel motor vehicle emissions control has been a joint venture with the EU under a bilateral free trade agreement begun in 2011. The latest agreement on diesel motor vehicle regulation came from the annual meeting of the Working Group on Motor Vehicles and Parts held June 10 in Seoul. "Both sides agreed to introduce PEMS and develop common standards," Park Yun-jae, director of the Transportation Environment Division at the Ministry of Environment, told reporters on June 15.

Separately, South Korea plans to introduce on-road evaluation for heavy-duty diesel vehicles weighing 3.5 tons or more. According to the ministry, 68 percent of all nitrogen oxides emissions in the capital region around Seoul comes from transportation, and 76 percent of pollution from transportation in the region is attributable to diesel-powered vehicles.

The rising popularity of diesel cars among South Korean consumers is another factor contributing to diesel exhaust pollution. Diesel cars accounted for 40.7 percent of all passenger vehicles sold in South Korea in 2014, up from 29.7 percent in 2012, according to the ministry. Seven out of 10 new imported cars sold in South Korea are powered by diesel.

74. South Korea to Cut 2030 Greenhouse Gas Emissions By 37 Percent from BAU Levels

South Korea has finalized its 2030 target of reducing greenhouse gas emissions by 37 percent from business-as-usual (BAU) levels, higher than its earlier plan for a 15-30 percent cut.

The country is among the world's top 10 carbon emitters, so any steps it takes to curb emissions are key to global efforts to combat greenhouse gases in the environment.

The country's emissions are projected to reach 850.6 million tons of carbon dioxide equivalent by 2030 based on BAU levels, a joint statement from ministries such as environment, trade and energy, and finance said on Tuesday.

Earlier this month, Seoul outlined four scenarios for the country's emissions target and said a final reduction rate, of either 14.7, 19.2, 25.7 or 31.3 percent from BAU levels, would be set after holding a public hearing.

"We decided to raise the target from the reduction scenarios, considering our leadership in climate changes such inviting GCF (Green Climate Fund), our global responsibility, and opportunity to develop new energy business and innovate manufacturing sectors," the statement said.

The Green Climate Fund (GCF) was designed "to make a significant and ambitious contribution to the global efforts towards attaining the goals set by the international community to combat climate change" under the U.N. Framework Convention on Climate Change, and is located in South Korea, its website said. (www.gcfund.org)

The final target will be submitted to the U.N. on Tuesday, according to the joint statement.

In 2009, South Korea voluntarily set to cut greenhouse gas emissions in 2020 to 30 percent below BAU levels.

In line with its plan to limit climate-changing greenhouse gas emissions, South Korea in January started the world's second-biggest carbon emission market that imposes caps on emissions from 525 of the country's biggest companies.

But trading has been slow to pick up with industry participants urging the government to review its carbon emission reduction target for 2020 while also complaining of higher costs, saying permits handed out were less than what had been requested.

SOUTH AMERICA

75. Scania Signs Order for Natural Gas Buses in Cartagena

The Colombian city of Cartagena will use 147 Scania Euro VI natural gas buses on its new transport system as part of Scania's largest deal to date on Euro VI natural gas technology in South America. Cartagena has selected Scania as the exclusive provider for two trunk lines for the city's brand new Bus Rapid Transport (BRT) system, called Transcaribe. Scania will provide 147 Euro VI natural gas buses to the city as well as service and maintenance contracts. With these buses, Cartagena will become the first city in Colombia to use natural gas for urban transport.

Various companies have been chosen to operate the new BRT, including Sotramac and Transambiental. All the buses will utilize the Scania Fleet Management system which provides real time data from the vehicles on matters such as fuel-consumption, routes, service needs and driver behavior. Scania will be responsible for providing both operators with the buses as well as ongoing maintenance of the vehicles. The first gas buses will begin operating on Cartagena's BRT in the second half of 2015.

Heavy-duty engine emission standards in Colombia are set at Euro IV and Euro IV diesel fuel with 50 ppm sulfur has been available since 2013. Municipal governments in Columbia have the ability to require stricter emission standards for some buses used for public transportation in their jurisdictions.

76. Chile Declares Environmental Emergency in Capital, Santiago, Over Air Quality

Chilean authorities decreed the first environmental emergency in Santiago in more than 16 years on June 22nd as levels of breathable particulate material reached critical levels in parts of the city. To improve air quality, the head of the capital's regional government, Claudio Orrego, banned the use of wood stoves, ordered the closure of about 1,000 fixed sources of emissions, and removed from the roads 40 percent of vehicles with catalytic converters and 80 percent of those without, while reserving four key road arteries for public transport only.

"This is an extraordinary measure which reflects to the poor air quality, which put at risk the health of children and old people," he said.

The emergency action marks the first time authorities have declared an emergency over fine particulate matter (PM-2.5), which was incorporated into Chile's air quality system only last year. Orrego blamed the poor air quality on the lack of rains during this, its winter season, that he said normally clean the atmosphere. Santiago is experiencing its driest June in more than 40 years, he said.

Orrego said the government is working on new air pollution plans for the Chilean capital that would meet the country's higher environmental standards. One step could be to encourage drivers to switch to electric and gas-powered vehicles.

77. U.S., Brazil Announce New Climate Initiatives; Seek Momentum before Paris Talks

President Barack Obama and Brazilian President Dilma Rousseff committed to get 20 percent of each nation's electricity in 2030 from non-hydropower renewable sources in an effort to build momentum for an international agreement on climate change later this year in Paris.

Brazil also committed to restore 12 million hectares of forests—an area approximately the size of Pennsylvania—and eliminate illegal deforestation by 2030, as the presidents released a joint statement June 30 vowing to pursue an "ambitious" climate accord. The actions are "new and significant," senior White House advisers said.

"This is a big deal," Brian Deese, senior adviser to the president on climate issues, told reporters June 30. "For the United States, it will require tripling the amount of renewable energy on our electricity grid. For Brazil, it will require more than doubling."

The announcement, made while Rousseff visited the U.S., notably did not include a formal climate pledge, known as an Intended Nationally Determined Contribution (INDCs), from Brazil to address greenhouse gas emissions. The statement, however, said the nation of more than 200 million planned to put forth a "fair and ambitious" climate pledge that "represents its highest possible effort beyond its current actions."

Obama and Rousseff's statement came on the same day as China formally pledged to cut the carbon intensity of its economy 60 percent to 65 percent from 2005 levels by 2030. The U.S. has previously pledged to cut greenhouse gases by 26 percent to 28 percent by 2025 from 2005 levels.

Deese said he had not seen China's pledge, but said the administration will continue to "encourage more nations to implement more ambitious measures to cut global emissions" through the Paris talks. The agreement with Brazil is the latest in a series of bilateral agreements with major emitters brokered by Obama, as he seeks to boost the chances of reaching a major international agreement later in 2015.

During a press conference, Obama said the new commitments from Brazil, as well as previous progress with China and India, showed the world's major emitters could come together and reach an agreement in Paris later in 2015.

"Following progress during my trips to China and India, this [announcement] shows that the world's major economies can begin to transcend some of the old divides and work together to confront the common challenge that we face, something that we have to work on for future generations," Obama said. "I'm confident that this will lead to a strong outcome in Paris."

The joint statement said key components of an ambitious global agreement would include strong and credible transparency to evaluate progress countries make toward pledges, regular updating by countries to promote greater ambition over time and "periodic stocktaking" to evaluate the overall effectiveness of the agreement.

In addition, Obama and Rousseff said they would pursue an agreement using the principle of "common but differentiated responsibilities and respective capabilities" to distinguish between developed and developing nations.

Some major emitters, including China, have expressed significant reservations about international supervision of progress toward climate goals. Deese said U.S. negotiators continue to have "constructive conversations" about that point. He also said Brazil and the U.S. have "shared recognition of the value of having that type of mechanism and a shared commitment to keep working toward that."

The progress by the Western Hemisphere's two biggest countries comes as top United Nations and other officials expressed concern June 29 that more than 190 nations are not negotiating with enough urgency toward a final climate accord.

Deese called the commitments on energy from both nations to ramp up their renewable energy usage an ambitious but achievable objective. "We believe that this is an ambitious target, but it's one that's actually achievable in a way that will actually create new, low-cost opportunities for the American economy," he said. "But to achieve it, we're going to have to continue to hit our marks in implementing the regulations that we've identified to date and providing those long-term incentives."

No new laws or regulations will be needed to achieve those renewable energy goals beyond efforts already announced by the Obama administration, according to Deese. Instead, the administration believes implementing regulatory efforts like the Environmental Protection Agency's carbon pollution limits for power plants and private sector forces will allow the U.S. to meet the renewable energy goals.

In addition, both nations agreed to form a high-level working group on climate change "aimed at enhancing bilateral cooperation on issues relating to land use, clean energy and adaptation, as well as policy dialogues on domestic and international climate issues."

Obama and Rousseff also agreed to work multilaterally through the Montreal Protocol to consider proposals to phase out the use of hydrofluorocarbons (HFCs). Though HFCs, commonly used as refrigerants, are not ozone-depleting, they have a global-warming potential between 140 and 11,700 times that of carbon dioxide. The European Union has proposed that industrialized countries cut their average HFC production/consumption by 2035 to 15 percent from 2009 baseline levels.

MIDDLE EAST

78. Israel's Comptroller Slams Environment Ministry on Industrial Air Pollution

The Environmental Protection Ministry has failed to monitor or address industrial air pollution even though it has the legislative means to do so, Israel's State Comptroller Yosef Shapira charged in his 2015 annual report. The report examined industrial compliance with air pollution standards across Israel, including in the Haifa Bay area, home to Israel's largest port and petrochemical industries. Its findings, released on May 5th, follow claims of government inaction by environmental groups and local residents.

Shapira criticized the ministry for failing to update air pollution regulations or complete the process of classifying factories according to their polluting potential. By the audit's conclusion in October 2014, almost four years after the 2011 Clean Air Law took effect in Israel, the ministry had yet to seek Knesset approval for new air pollution prevention regulations, as the law envisioned, the comptroller said.

In addition, no punitive steps were taken against factories that failed to submit their own emission samples, the report noted. "Thus, the Environmental Protection Ministry's ability to maintain proper control over periodic samplings of local emissions of pollution caused by factories was highly impaired," Shapira wrote.

The ministry should "act to correct the deficiencies" noted in the report, "streamline its supervisory system, and, optimally, use the enforcement measures granted to it against violators of the law and its provisions—and the sooner the better," Shapira wrote.

The ministry said it had prepared a National Program to Prevent Air Pollution at a cost of 680 million shekels ($176 million), but that the Treasure provided only 140 million shekels for its implementation. The report demonstrates "where cutback policies in the struggle against air pollution are leading, "the ministry said, charging that environmental budget cuts were "endangering the lives of thousands of Israelis."

Nevertheless, the ministry said it has succeeded in reducing industrial pollution "by dozens of percentage points," including a 70 percent reduction in industrial pollution in the Haifa Bay area.

79. Israel Environment Ministry Releases Plan for Haifa Bay Cleanup Efforts

Israel's Environment Ministry released the main points of a plan to combat air pollution and other environmental risks in the Haifa Bay area, just two weeks after it convened a task force to examine the issue. Haifa Mayor Yona Yahav welcomed the ministry's stepped up efforts, but stressed that adherence to strict timetables and coordination among relevant ministries will be crucial moving forward.

The task force said it also will formulate a comprehensive bill on the subject for government approval.

The plan, announced June 14, includes stricter factory emission standards aimed at reducing the use of highly polluting fuels, and programs encouraging the use of cleaner fuels, such as natural gas. It also includes a ban on new diesel-operating engines and installation of particle filters on existing diesel vehicles and calls for removing a controversial ammonia storage tank from the area and conducting more spot checks of industrial smokestacks.

Israel's northern port city saw anti-business protests in April after reports linked a high rate of cancer, especially among children, to local air pollution levels. "The situation in the Haifa Bay must change," Environmental Protection Minister Avi Gabbay said. "The hundreds of thousands of citizens of the Haifa metropolitan region have a right to quality air and quality life. The ideas in the work plan, through cooperation among all the parties, will bring about a significant change."

The plan will be implemented by the Environmental Protection Ministry, the Haifa municipality and the Haifa District Municipal Association for Environmental Protection.

AFRICA

80. BMW, Nissan to Expand Green Cars Plug-In Network in South Africa

The South African units of BMW and Nissan will build a national grid for electric and hybrid cars to expand sales of vehicles that could reduce pollution in Africa's top auto market. The two companies will roll out fast-charging stations from now until 2017 which BMW and Nissan cars can use to power up. Nissan introduced its all-electric Leaf in South Africa in 2013, while BMW launched its i3 and i8 models in March.

Consumers would charge all-electric cars such as Nissan's Leaf by plugging into an outlet, while hybrid versions such as BMW's i8, also has a gasoline engine.

The firms said although South Africa is experiencing severe power supply shortages, their plans would not be affected. State-owned power utility Eskom has been forced to frequently curtail electricity to residents and businesses in a bid to preserve the national power grid. "It is not expected that the country's power crisis will affect this initiative in any way. The companies are also exploring renewable energy sources to power their charging grid," said Nissan spokeswoman, Veralda Schmidt.

Battery-powered cars have failed to live up to their initial hype globally, with drivers put off by the slow roll out of recharging stations, and limited range - despite generous sales incentives in some markets. Because the batteries, cabling and cooling systems for electric cars cost more than a conventional combustion engine, electric vehicles have struggled to gain widespread acceptance among price-sensitive customers, particularly if the same model is available cheaper with a more conventional powertrain.

Some electric cars require lengthy charging, reducing their attractiveness for customers planning to drive longer distances frequently.

BMW and Nissan said their national network of stations where vehicles can charge their batteries will also include smaller vehicle chargers using alternating current in some regions.

"In order for the introduction and expansion of electric vehicles as well as plug-in hybrid electric vehicles to be successful in this market, we need to work together," Tim Abbott, managing director of BMW South Africa said in a statement.

81. Energy Report Says Most Africans Live Without Regular Source of Electricity

More than 60 percent of the people in Africa lack reliable sources of electricity, many are still burning wood or dung for fuel, and the prospects for changing that differ markedly by country, the African Development Bank said in a recent report. While the north has an abundance of oil, sub-Saharan Africa is facing major challenges with its heavy dependence on traditional biomass, very limited access to modern energy and rapid urbanization, according to the report released in May.

Even those African households with electricity often continue to use wood or dung for cooking because of the high price of appliances and the lack of reliable and affordable power, it said. Across sub-Saharan Africa, the rural electrification rates are said to be just 10 percent.

The report estimated that reliance on traditional stoves or open fires causes indoor air pollution that in 2013 accounted for some 600,000 deaths in Africa.

Landlocked countries on the continent are experiencing delays in receiving imported energy and are hampered by inadequate reserves. They are heavily reliant on imported oil and have seen the cost of energy supply soar, the report said.

Even South Africa is struggling to keep the lights on and has instituted a “load-shedding” system of planned cutoffs throughout the country, expected to be in place for the next two years.

But there is also a lot of untapped potential, according to the bank. “Energy is also a field of opportunity for Africa,” said Solomon Asamoah, a vice president in charge of infrastructure at African Development Bank. “The continent has significant share of the world's renewable energy sources, of which only a fraction is under development. Africa has the potential to leapfrog over carbon-intensive technologies and meet most of its future energy needs from renewable sources, putting it firmly on the path to green and inclusive growth.”

But such changes won't come cheaply. Overcoming Africa's energy deficits would require investments of more than $60 billion a year until 2040, said Asamoah. “As this amount is far beyond the capacity of any single institution, we are working to leverage other sources of finance and establish strategic partnerships with other development partners,” he added.

Jacob Maroga, former chief executive officer of South Africa's troubled state power utility Eskom, said challenges differ by country on the continent. “Access to electricity is a problem on the continent. It does not seem as if there is a shortage of funds to deal with the issues, but whether there is enough capacity and the legislative environment to enable development,” said Maroga.

GENERAL

82. New Study Links Weather Extremes to Global Warming

The moderate global warming that has already occurred as a result of human emissions has quadrupled the frequency of certain heat extremes since the Industrial Revolution, scientists have reported, and they warned that a failure to bring greenhouse gases under control could eventually lead to a 62-fold increase in such heat blasts.

The planetary warming has had a more moderate effect on intense rainstorms, the scientists said, driving up their frequency by 22 percent since the 19th century. Yet such heavy rains could more than double later this century if emissions continue at a high level, they said.

“People can argue that we had these kinds of extremes well before human influence on the climate — we had them centuries ago,” said Erich M. Fischer, lead author of a study published recently by the journal Nature Climate Change. “And that’s correct. But the odds have changed, and we get more of them.”

The study by Dr. Fischer and his colleague Reto Knutti, of the Swiss Federal Institute of Technology in Zurich, is not the first to attribute large-scale changes in extreme weather to human influence on the climate. But it is among the first to forecast, on a global scale, how those extremes might change with continued global warming. The question is important because while a gradual increase in average temperatures can have profound ecological consequences, it is weather extremes that have the greatest effect on human society. A 1995 heat wave in Chicago killed hundreds of people, and a 2003 heat wave in Europe killed an estimated 70,000.

Scientists believe both were made more likely by the human emissions that are warming the planet, and heat on that scale will become commonplace if emissions are allowed to continue unabated. For now, though, such heat extremes — Chicago temperatures were near or above 100 degrees for four days running that July — are still rare, which makes them difficult to study in a statistical sense.

For their paper, Dr. Fischer and Dr. Knutti focused on more common heat and precipitation extremes. Using computer analyses of what the climate would be like if the Industrial Revolution had never happened, they focused on the sort of weather extremes that would be likely to occur in any given location on the earth about once in 1,000 days, or a little less than three years.

What constitutes a one-in-1,000-day extreme varies from place to place; after all, a hot day in North Dakota might seem pretty routine in Texas. But such extremes can be damaging wherever they occur — especially hot days, which can cut farm yields and drive up food prices.

Since the 19th century, the earth has warmed by about 1.5 degrees Fahrenheit. Computer models suggest that has driven up heat extremes four- to fivefold, according to the new study. If global warming can be brought under control as rapidly as many environmental activists would like, keeping global warming below three degrees Fahrenheit, the new study found that heat extremes might increase only 14-fold later this century, compared with their frequency in the preindustrial world.

But runaway emissions, causing the planet to warm by more than five degrees Fahrenheit, would lead to a 62-fold increase in heat extremes, the researchers found. Other studies have forecast levels of heat and humidity by late this century that could make it dangerous for people to work and play outside, possibly for weeks on end.

While it might seem obvious that global warming would lead to more heat extremes, changes in heavy precipitation can seem less intuitive. Yet scientists predicted them decades ago, based on the principle that warmer air can take up more moisture from the surface of the ocean. The increase is leading to heavier rainstorms across large parts of the United States, with the biggest effect in the Northeast, previous research found. At the same time, higher temperatures are drying out the soil and worsening the effects of droughts when they do occur, as in California over the last few years.

"The bottom line is that things are not that complicated," Dr. Knutti said. "You make the world a degree or two warmer, and there will be more hot days. There will be more moisture in the atmosphere, so that must come down somewhere."

Myles R. Allen, a climate scientist at the University of Oxford who was not involved in the new paper, said in an interview that "the method they use to add up risk on a global scale is spot on." While previous research focused on particular disasters like the European heat wave, he added, the new approach does a better job of capturing the influence of greenhouse gases on more common types of weather extremes. "We keep asking people to do something about climate change," Dr. Allen said. "They deserve to know what climate change is doing to them."

83. CCAC High-Level Assembly Endorses Framework for Five-Year Strategic Plan

The sixth High-Level Assembly of the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC) has initiated the development of a detailed implementing and planning instrument, the 'CCAC Five-Year Strategic Plan.' The Assembly endorsed a framework for the

Plan with a view to launching it at the next High-Level Assembly, which will be held on the margins of the Paris Climate Change Conference in December 2015.

Jane Nishida, Co-Chair for the CCAC Task Force on the Plan, described the elements of the framework, emphasizing the need for: a strategic focus on polices, regulations and practices of partners and stakeholders to deliver substantial short-lived climate pollutant (SLCP) reductions in the near- and medium-term; using peer-to-peer cooperation to catalyze ambitious action and CCAC participation in key forums and increasing visibility of SLCPs in the media to mobilize support; and leveraging finance at scale by working with national development agencies and development banks to mainstream SLCPs into development planning and connecting project proponents and financiers to demonstrate that SLCP projects are bankable. In endorsing the framework, the Assembly also agreed the implementation plan would include methods for demonstrating impact.

At the opening of the Assembly, UN Secretary-General Ban Ki-moon and Maria Neira, Director, Public Health and Environment, World Health Organization (WHO), highlighted linkages between CCAC's work and climate change and public health. Ban emphasized the important contribution CCAC can make toward the anticipated 2015 global climate change agreement, noting the practical solutions CCAC has advanced. Neira stressed that an estimated 4.3 million deaths are caused by indoor air pollution and 3.7 million are attributed to outdoor air pollution annually. The Assembly took place on the margins of the World Health Assembly, which Neira highlighted is anticipated to adopt a resolution on air quality and health.

During a discussion on the Lima-Paris Action Agenda and the "Road to Paris" strategy prepared by the CCAC Working Group, delegates discussed concrete actions that individual partners, as well as the Coalition, are taking to engage in the international community's efforts against climate change. A number of objectives for CCAC's participation in the Paris Climate Change Conference were named, including: launching the Five-Year Strategic Plan; ensuring every COP 21 participant leaves with a better understanding of SLCPs; demonstrating commitment to increasing pre-2020 ambition by showcasing results; increasing engagement of key countries and private sector actors through targeted outreach; and encouraging countries to include SLCPs in their intended nationally determined contributions (INDCs) and statements.

The Assembly also heard updates from partners on their progress mitigating SLCPs. The Black Carbon Finance Study Group launched the 'Black Carbon Finance Study Group Report 2015,' which outlines strategies to increase funding for black carbon reduction. (See below)Delegates also welcomed the Philippines as CCAC's 104th partner during the meeting. The sixth High-Level Assembly of the CCAC took place on 20 May 2015, in Geneva, Switzerland.

84. New Report Outlines Strategies to Increase Funding for Black Carbon Reduction

Reducing black carbon emissions could prevent millions of premature deaths annually and play an important role in the global fight against climate change. Yet despite these benefits, an array of black carbon abatement measures that are technically within reach have not yet been financed and deployed to their full potential.

A report released by the Climate and Clean Air Coalition (CCAC) finds that existing funds are already in a position to finance businesses, activities, technologies, and policies that will contribute to cutting black carbon emissions, and that several black carbon-rich sectors are sufficiently mature to absorb finance. The report also outlines key strategies and steps needed to scale up black carbon finance over time. The work was led by the World Bank Group, a co-leader of CCAC's Finance Initiative.

At the launch of the 'Black Carbon Finance Study Group Report' Christian Grossman, Director of the World Bank's Climate Business Department, Climate Change Group, said the rapid implementation of measures to reduce black carbon in a range of sectors would deliver multiple benefits and near term results in health, climate and other areas. "We need to urgently find ways to reduce emissions of black carbon and other short-lived climate pollutants on a wide scale," Mr. Grossman said. "Public and private financiers can and need to adopt black carbon performance measurements to direct new and existing financial flows toward technology that can lower these emissions."

"This shift can start today in sectors like municipal transport and residential clean cooking spaces where investment already exists and performance management tools are nearly or already in place. We should also increase our efforts to strengthen these tools in other sectors to create an environment where finance for black carbon can be made available on a much wider scale."

Helena Molin Valdes, Head of the Climate and Clean Air Coalition Secretariat, welcomed the report and said Coalition partners were active in numerous black carbon mitigation initiatives across multiple sectors.

The report recommends funding the development of black carbon performance standards so that investors can screen potential projects to ensure that activities are reducing emissions and achieving climate and health benefits. However, practical steps can be taken immediately in the diesel transportation and residential cooking sectors.

According to the World Health Organization indoor air pollution, of which cooking is leading contributor, causes approximately 4.3 million premature deaths a year. Programs to improve cookstoves are underway in many parts of the world. Mrs. Bahijjahtu Abubakar National Coordinator, Renewable Energy Programme, at the Federal Ministry of Environment, Nigeria, says that their cookstove program has created a range of benefits in her country.

In the transportation sector, the suggestion is for development finance institutions to use concessional loans and grants to incentivize diesel vehicle owners to transition to lower-soot or soot-free engines. Results-based finance instruments can be used to incentivize the adoption and continued maintenance of diesel abatement technology. In practice, funds could flow through designated national authorities to municipalities, private fleet owners, and other beneficiaries.

The report also identified four additional black carbon-rich sectors that offer strong potential for impact and action in the near to medium term. These include: Brick kiln efficiency and the adoption of alternative materials, replacing kerosene lanterns, adopting alternative of agricultural residues to avert burning, and reducing emissions from oil and gas flaring.

Over the longer term the report recommends cross-cutting strategies like including black carbon in development finance investment decision making. Such a step could see development banks offer sovereign borrowers more concessional loan terms if they choose to follow a low carbon pathway, or offer loans and grants to finance transformation of a particular sector.

Black carbon is a byproduct of burning diesel, coal, firewood, and crop residue and its negative impacts are both fast-acting and extensive. Black carbon particles absorb light and re-radiate it as heat in the atmosphere and act much more intensely than carbon dioxide albeit for a much shorter time. Recent studies show that black carbon may be responsible for close to 20% of the planet's warming, making it the second highest contributor to climate change after carbon dioxide.

Black carbon is also a component of fine particulate matter (PM 2.5). Exposure to fine particulate pollution has a significant impact on human health. Indoor and outdoor air pollution causes close to 7 million premature deaths a year. Tens of millions more suffer from related, preventable diseases, including cardiovascular diseases, pneumonia, stroke, lung cancer, and chronic obstructive pulmonary disease.

85. Arctic Sea Ice Reaches Its Record Low Winter Maximum

Arctic sea ice this year is the smallest in winter since satellite records began in 1979, in a new sign of long-term climate change, U.S. data showed. The ice floating on the Arctic Ocean around the North Pole reached its maximum annual extent of just 14.54 million square kms on Feb. 25 – slightly bigger than Canada – and is now expected to shrink with a spring thaw. The ice was 1.1 million sq. kms smaller than the 1981-2010 average, and below the previous lowest maximum in 2011. With the return of the sun to the Arctic after months of winter darkness, the ice shrinks to a minimum in September.

The U.N. panel of climate scientists links the long-term shrinkage of the ice, by 3.8 percent a decade since 1979, to global warming and says Arctic summertime sea ice could vanish in the second half of the century.

The U.N.'s World Meteorological Organization says 2014 was the warmest year since records began in the 19th century. Almost 200 nations have agreed to work out a deal in December in Paris to slow global warming.

86. Pope's Climate Change Aide Urges Business to Favor Planet over Profit

Pope Francis' top aide on climate change urged businesses not to let the pursuit of profit get in the way of protecting the planet. The remarks came as the Vatican is due to release a papal encyclical, or formal letter, on the issue. Cardinal Peter Turkson, who helped draft the encyclical, said the paper would be presented in the second half of June, two months before the pope is due to address the U.S. Congress and a United Nations meeting on sustainable development.

"Our lives must become more sustainable," Turkson told a conference on economic growth and sustainability organized by the Vatican and the Netherlands. "This is not just about business and profits." Turkson said business had a responsibility to produce "goods that are good and services that truly serve... and provide a benefit for others and not just for themselves." He cited the United States, where now "there are more jobs in solar energy than in the coal sector."

Pope Francis has said he believes man is primarily responsible for climate change. Though previous pontiffs have addressed environmental issues, the encyclical is expected to be the most thorough papal teaching yet on links between economic development, poverty reduction and environmental protection. The pope hopes the encyclical will influence world leaders to enact sweeping climate change policies at a summit in December.

The Vatican's recent warnings against climate change have been criticized by some who say the pontiff risks confusing people by making it seem that climate change is part of Catholic faith. They say the pontiff should not wade into highly-politicized scientific debates.

Turkson defended the pope's activity. He said the point was not politics, which was a reality of everyday life. "The issue is how much people are aware of scientific data that the climate is changing."

87. World's Energy Giants Responsible For 31% Of CO2

A third of annual greenhouse gas emissions globally were caused by just 32 energy companies, including France's Total, Royal Dutch Shell and Germany's RWE, a new study has shown. The data compiled by Thomson Reuters and BSD Consulting included both greenhouse gases emitted directly by the companies and those resulting from the use of their products.

Other Europe-based companies on the list, a key subset of the world's largest publically traded businesses, include Spain's Repsol, Italy's Eni and the UK's BP.

The greenhouse gas emissions from the companies and use of their products increased by 1.3% in the period 2010-2013, the report said. By contrast, they should have been decreasing by 1.4% per year to avoid dangerous climate change in line with the recommendations of the UN Environment Program's emissions gap report.

"If we are to balance our needs for energy with our harmful effects on our environment and subsequent generations, it is critically important for energy consumers and producers alike to reduce total fossil fuel consumption, particularly in its most carbon intensive forms," said John Moorhead of BSD Consulting, co-author of the report.

The report comes ahead of the next round of UN climate talks in Bonn next month where negotiators will attempt to narrow down the options for inclusion in a new climate deal to be agreed in Paris in December.

88. International Maritime Organization Adopts Polar Code's Environmental Provisions

The International Maritime Organization has adopted the environmental provisions of the Polar Code that will require new ships operating in Arctic and Antarctic waters to follow strict pollution-prevention rules beginning in 2017, the United Nations agency said on May 18th. The IMO said newly adopted environmental provisions will apply to ships built after Jan. 1, 2017. The Polar Code will ban discharge of oil or oily mixtures, noxious liquid substances, and sewage and will restrict discharge of garbage into polar waters.

Simon Walmsley, marine manager at the environmental activist group World Wildlife Fund UK, told reporters that the provisions "don't go far enough." He said, "Protective measures to restrict carriage and phase out" the use of heavy fuel oil, which he called "the biggest threat to polar waters," were omitted from the code.

The IMO's Marine Environmental Protection Committee also announced after a week of meetings that it has made progress on the system ships operating worldwide should use to report their individual carbon dioxide emissions. International shipping emitted 796 million metric tons of carbon dioxide in 2012, 2.2 percent of the world's total carbon dioxide, according to IMO statistics.

The organization said Marine Environmental Protection Committee members provisionally agreed that ships of more than 5,000 gross tons should include in an annual carbon dioxide data collection system details such as ship identification number, technical characteristics, and total annual fuel consumption by fuel type and in metric tons.

The shipping industry and environmentalists have called for the creation of a global system of monitoring, reporting and verifying emissions from ships.

The London-based International Chamber of Shipping, which represents more than 80 percent of the world's merchant fleet, said it was “pleased” that “commercially sensitive data about individual ships” would not be included in the proposed data collection system. By contrast, the European Commission has included commercial data in its separate reporting requirements that it plans to introduce beginning in 2018.

In addition, the committee inched closer to putting into force rules that would require ships to treat and manage ballast water to minimize damage caused by aquatic invasive species. The action came during the IMO's 68th meeting, which ended May 15th in London. The Marine Environmental Protection Committee provisionally agreed that ships that have “first-generation” ballast water management systems that follow the current IMO guidelines would not be penalized once tougher requirements are in place.

Stricter rules on how ships treat and manage ballast water to kill off aquatic organisms and pathogens that can cause damage when released into a non-native environment, could come into force once the so-called Ballast Water Convention is ratified by at least 30 countries that collectively represent 35 percent of the world's merchant shipping tonnage.

The IMO said 44 countries have ratified the convention and they account for 32.8 percent of the global merchant shipping tonnage.

The committee said it considered a call from the Marshall Islands—the world's third biggest shipping registry—to reduce emissions from international shipping, but decided to postpone debate to a future session. “We are in for a very slow process that amounts to, too little too late for small-island developing states,” said Walmsley, noting that the low-lying Marshall Islands face direct damage from rising sea levels caused by global warming.

The committee adopted a resolution to extend the special protection-known as a Particularly Sensitive Sea Area (PSSA) in place for the eastern limit of the Great Barrier Reef and Torres Strait, to include the southwest part of the Coral Sea, part of Australia's Coral Sea Commonwealth Marine Reserve, a remote ocean ecosystem that provides refuge for a range of threatened, migratory and commercially valuable species.

89. U.N. Climate Chief Says Governments Certain To Seal Paris Climate Deal

Governments are certain to sign a global climate deal in Paris in six months' time even though most countries have yet to outline how they plan to cut emissions, the United Nations' climate chief said recently. Almost 200 governments are due to meet at a conference in Paris from Nov. 30 to Dec. 11 to agree on a deal to slow global warming. "Governments are actually very well on track...there is no doubt that this agreement will be forged in Paris," Christiana Figueres, head of the U.N. climate change secretariat, said in an interview at a carbon market event in Barcelona.

Figureres' comments come just a week after French President Francois Hollande said he was worried about a lack of progress towards a climate deal in the French capital. So far, just 37 of

196 U.N. member states have submitted plans to the United Nations, outlining their actions to slow global warming beyond 2020.

The plans, known as Intended Nationally Determined Contributions (INDCs) in U.N. jargon, are meant to be the building blocks for a deal in Paris. We expect many more critical ones to come in over the next few weeks and months and then we expect another large crop of INDCs to be coming in the third quarter (ahead of Paris)," Figureres said.

A draft negotiating text to work towards the Paris deal was agreed in February but Figueres said negotiators would, at the U.N. climate meeting starting next week in Bonn, trim down the 86-page document to a more manageable size. "We will first look through the duplications and how can the ideas and the solutions in the text be crystallized - expect a much more manageable product to emerge at the end of June," she said.

The United Nations was confident of a deal up to the last moment in 2009, when a summit in Copenhagen collapsed because of objections from a handful of countries that rich nations were failing to promise deep cuts in emissions.

90. IMF Says Energy Subsidized By $5.3 Trillion Worldwide

Governments around the world charge prices for energy that do not account for its harmful environmental, health and other side effects, amounting to a $5.3 trillion "post-tax" subsidy this year, the International Monetary Fund said in a new report.

The IMF said China in particular failed to charge its more than 1 billion consumers for the pollution that comes from heavy use of fossil fuels, adding up to a $2.3 trillion subsidy this year. The United States was the second-biggest offender, with an estimated $699 billion subsidy, followed by Russia, the European Union, India and Japan.

The report comes as almost 200 nations are trying to work out a deal to combat global warming ahead of a summit in Paris in December. Getting rid of fossil fuel subsidies and setting policies to price carbon pollution are seen as key international measures that would help keep temperatures from rising.

The IMF has long urged governments to get rid of "pretax subsidies" that allow firms and households to buy coal, gasoline or other fuel sources below their cost of supply. Many governments, including Egypt, India, Indonesia and Jordan, have recently raised domestic prices to match those internationally, said the Washington-based institution charged with policing global economic and financial stability.

But the Fund said it had turned its focus to the post-tax subsidies that mean prices fail to reflect costs like unfair tax advantages and deaths from pollution.

In its last study on the subject in 2013, the IMF estimated these post-tax subsidies amounted to $2 trillion in 2011, or 2.9 percent of the world's gross domestic product.

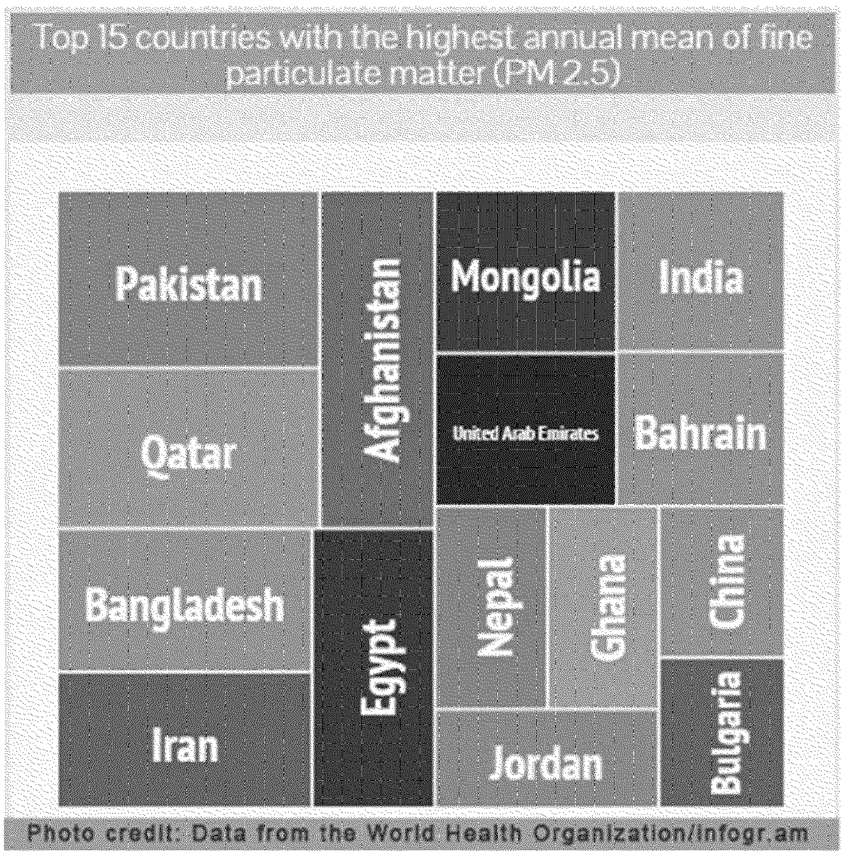
With new data about the extent of environmental damage, the IMF says these subsidies totaled $4.9 trillion in 2013 and should rise to $5.3 trillion this year, or 6.5 percent of global GDP. "The fiscal implications are mammoth: At $5.3 trillion, energy subsidies exceed the estimated public health spending for the entire globe," IMF economists Benedict Clements and Vitor Gaspar wrote in a blog post accompanying the report.

The IMF said about three-quarters of the damages from energy affect domestic consumers, meaning it is in countries' own interests to get rid of these subsidies.

91. World Health Assembly Tackles Air Pollution

The World Health Assembly approved the first international resolution aimed at combatting air pollution among the 194 member states of the World Health Organization (WHO) on May 26th. Eight million deaths globally are attributed to air pollution annually, a number that is only increasing, says Dr. Maria Neira, director of the WHO's Public Health and the Environment Department. "Air pollution represents, today, if not the biggest, then one of the biggest health challenges that we have in front of us, and we are very much committed in WHO to take all the action needed."

Much of that action will focus on high levels of fine particulate matter that comes from burning fossil fuels, mainly in motor vehicles, but also in factories and power plants. When inhaled, fine particulate matter is small enough to enter the bloodstream through the lung's alveoli. Of deaths due to outdoor air pollution, 80% are attributed to heart disease and stroke, and 20% to respiratory illnesses and cancers, according to a document released by the WHO on April 10th.



The WHO guideline for fine particulate matter, which was set a decade ago, is a mean of 10 µg/m3 annually. However, low-income countries are nowhere near meeting these standards.

The top 15 countries with the highest annual mean of fine particulate matter (PM 2.5)

About two decades ago, high-income countries, including Canada and the United States, noted the effect industrialization had on air quality and began looking for better ways to continue to develop economically, without putting the population's health at risk.

In Ontario, levels of fine particulate matter have dropped 30% since 2004, according to the province's annual air quality report. One of the main reasons for this decline was the closure of coal-fueled electrical generation plants in favor of alternative sources, such as nuclear power and natural gas.

Recently, China "declared war" on air pollution, and in India, Prime Minister Narendra Modi launched the country's first air-quality index in April. These two countries have some of the highest levels of air pollution in the world.

According to the WHO, Delhi is the most polluted city in the world, with an annual mean of fine particulate matter of 153 μg/m3; by comparison, Toronto levels hover around 8 μg/m3.

The World Health Assembly's resolution was prepared by a number of countries, including Chile, Colombia, France, Norway, Ukraine, the US and Zambia.

The resolution highlights strategies such as better policies to promote cleaner public transit and clean-energy sources, like solar and wind power, and reducing emissions of carbon dioxide, methane and black carbon. The resolution calls for health ministers to take a larger role in the environment debate.

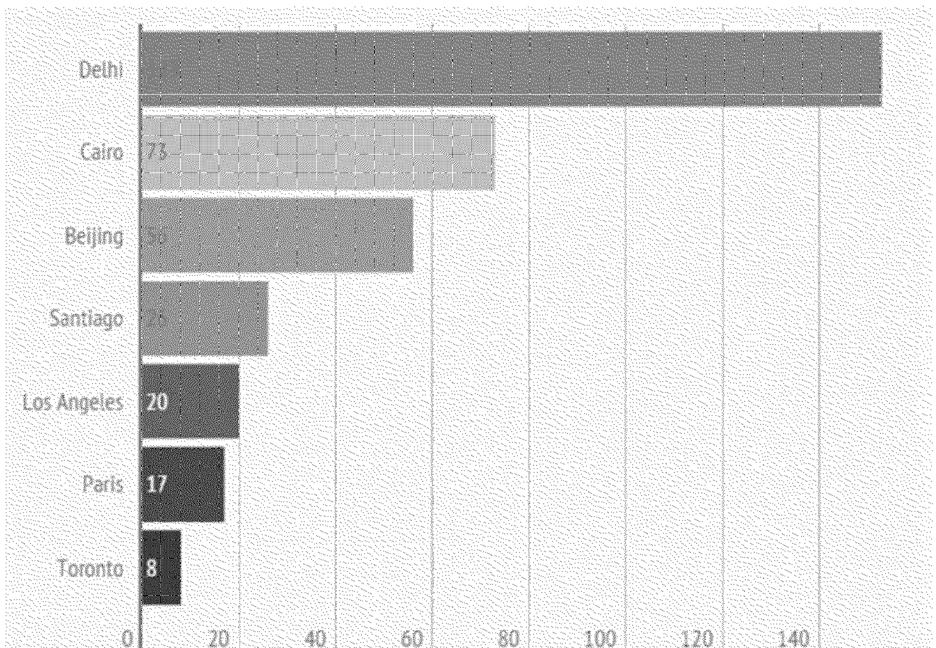


Photo credit: Data from the World Health Organization/Infogr.am

Comparing air quality in cities by their annual mean of fine particulate matter (PM 2.5)

"We expect member states to agree on doing more data collecting and more monitoring of the trends of how air pollution is impacting the health of the population," Neira says.

At the May 18–26 assembly in Geneva, Switzerland, Marcelo Mena-Carrasco, Chile's vice-minister of environment, said he is pushing for environment ministries to join the health community to "put a human face on climate mitigation."

At the end of 2014, Chile introduced a plan to reduce emissions by over 70% by 2025. It includes a new carbon tax on power plants geared to the amount of air pollution emitted, and a tax on new cars based on the fuel efficiency of the vehicle. Diesel car sales have already declined by 25%, said Mena-Carrasco.

"What we're trying to do is harness the market forces to make clean energy, clean vehicles, cheaper and easier to buy." Mena-Carrasco says he bikes to work every day, despite having his own chauffeur.

Member states have proposed that next year, the World Health Assembly discuss creating a road map to guide the global response to the harmful effects of air pollution on health.

92. Pope Francis Stresses Moral Dimension of Climate Change Cause

Pope Francis's much-anticipated encyclical on climate change and the environment unequivocally puts the Catholic Church in the camp of those advocating a strong response to rising temperatures. The ambitious 183-page document, released simultaneously in nine languages on June 18th, casts the debate over climate change and environmental protection in a moral light, calling for humans to better protect what Francis called “our common house” and highlighting the issue as a key part of the effort to lift the world's least fortunate citizens out of poverty.

It is too early to know the impacts the document will have. Popes have issued more than 300 encyclicals in the past three centuries and they have occasionally changed the course of church history, though sometimes that is not clear for years or decades.

But Francis is leader of the world's 1.2 billion Catholics and his words are considered to be especially influential in parts of the developing world with large Catholic populations.

Within the church, bishops around the world received the document a few days ahead of its formal release to give them time to study it and to prepare their dioceses.

But the church is far from unified on this topic and many conservative Catholics—particularly in the U.S.—have been outspoken in their opposition. Vatican officials told reporters that clergy with opposing views would be allowed to voice their opposition.

In the United Nations climate negotiations process, delegates, UN officials and environmentalists have all expressed hope that Francis's stand on the issue would cast new light on the topic and have an impact on public opinion as negotiations enter the homestretch in trying to hammer out the world's first global climate change agreement by the end of the year.

The encyclical on climate change and the environment was praised by figures ranging from UN Secretary-General Ban Ki-moon, who called it “monumental,” to U.S. President Barack Obama, who said in a statement: “As Pope Francis so eloquently stated this morning, we have a profound responsibility to protect our children, and our children's children, from the damaging impacts of climate change.”

Heading up to the release of the encyclical, Vatican officials warned not to expect a detailed analysis of the climate change debate but rather the pontiff's reflections on the moral responsibility of people to act as effective custodians of the environment.

But the document included plenty of detail, particularly in Chapter 5, “Lines of Approach & Action,” reflecting the pontiff's views on solutions to the climate crisis. “We know that technology based on the use of highly polluting fossil fuels—especially coal, but also oil, and, to a lesser degree, gas—needs to be progressively replaced without delay,” the pope wrote. He stopped short of calling for an immediate phase-out, saying it is “legitimate to choose between the lesser of two evils” until renewable energy sources are more viable.

Francis also expressed support for a carbon tax, referring to the “obligation of those who cause pollution to assume its costs,” but he opposed the use of carbon credits and offsets, which he said, “can lead to a new form of speculation, which would not help reduce the emission of polluting gases worldwide.”

Referring to negotiations to reduce climate change, Francis said large, developed countries like the U.S. should do more: "Reducing greenhouse gases requires honesty, courage and responsibility, above all on the part of those countries which are more powerful and pollute the most," wrote Francis, an Argentine, who is the first pope from the developing world and repeatedly noted the inordinate harm to the world's poor from a changing climate.

In another section, he added that "enforceable international agreements are urgently needed, since local authorities are not always capable of effective intervention."

The pontiff supported the development of new technologies but warned against relying on them too much in efforts to reach a solution to the climate crisis. He said rising levels of greenhouse gases were a problem of too much consumerism, and he highlighted solar energy as the renewable energy source with the greatest potential.

"Everything in the encyclical is in line with the latest science," said Hans Joachim Schellnhuber, the founding director of the Potsdam Institute for Climate Impact Research, who was on a special panel appointed by the Vatican for the rollout of the encyclical.

Environmental lobby groups were almost universally supportive of the document, which many said could help jump-start the negotiations process ahead of the Nov. 30–Dec. 11 climate summit in Paris, where the world's first global agreement to fight climate change could be signed. "We hope that politicians and decision-makers will take the strong messages of the encyclical on board and that the outcomes of these international meetings will put the common interest first and be able to make the difference," said Bernd Nilles, secretary general of CIDSE, a Catholic climate advocacy group.

In his statement, Obama said he was "committed to taking bold actions at home and abroad to cut carbon pollution," and added: "As we prepare for global climate negotiations in Paris this December, it is my hope that all world leaders—and all God's children—will reflect on Pope Francis's call to come together to care for our common home."

But in the U.S., some Republicans who have questioned the role of humans in climate change expressed concern about the encyclical. (See story above.) "I disagree with the pope's philosophy on global warming," Sen. Jim Inhofe (R-Okla.), chairman of the Senate Environment and Public Works Committee, said in a statement. "I am concerned that his encyclical will be used by global warming alarmists to advocate for policies that will equate to the largest, most regressive tax increase in our nation's history. It's the poor that spend the largest portion of their expendable income to heat their homes, and they will be the ones to carry the heaviest burden of such onerous policies."

93. May Has Been a Month of Extreme Weather around the World

Even for a world getting used to wild weather, May seems stuck on strange:

- Torrential downpours in Texas that have whiplashed the region from drought to flooding.
- A heat wave that has killed more than 1,800 people in India.
- Record 91-degree readings in Alaska, of all places.
- A pair of top-of-the-scale typhoons in the Northwest Pacific. And a drought taking hold in the East.

"Mother Nature keeps throwing us crazy stuff," Rutgers University climate scientist Jennifer Francis says. "It's just been one thing after another."

Jerry Meehl, an extreme-weather expert at the National Center for Atmospheric Research, points out that May is usually a pretty extreme month, with lots of tornadoes and downpours. Even so, he says, this has been "kind of unusually intense."

The word "stuck" provides one possible explanation.

Francis, Meehl and some other meteorologists say the jet stream is in a rut, not moving nasty weather along. The high-speed, constantly shifting river of air 30,000 feet above Earth normally guides storms around the globe, but sometimes splits and comes back together somewhere else.

A stuck jet stream, with a bit of a split, explains the extremes in Texas, India, Alaska and the U.S. East, but not the typhoons, Francis says.

Other possible factors contributing to May's wild weather: the periodic warming of the central Pacific known as El Nino, climate change and natural variability, scientists say.

Texas this month has received a record statewide average of 8 inches of rain and counting. Some parts of the Lone Star State and Oklahoma have gotten more than a foot and a half since May 1. The two states have gone from exceptional drought to flooding in just four weeks.

Texas state climatologist John Nielsen-Gammon attributes the heavy rainfall to an unusually southern fork in the jet stream, a stuck stationary front and El Nino, and says the downpours have probably been made slightly worse by climate change. For every degree Celsius the air is warmer, it can hold 7 percent more moisture. That, Nielsen-Gammon says, "is supplying more juice to the event."

While it is too early to connect one single event to man-made warming, scientific literature shows "that when it rains hard, it rains harder than it did 20 to 30 years ago," says University of Georgia meteorology professor Marshall Shepherd.

As bad as the Texas flooding has been, the heat wave in India has been far worse - in fact, the world's fifth-deadliest since 1900, with reports of the 100-degree-plus heat even buckling roads. And it's a consequence of the stuck jet stream, according to Francis and Weather Underground meteorology director Jeff Masters.

When climate scientists look at what caused extreme events - a complex and time-consuming process that hasn't been done yet - heat waves are the ones most definitely connected to global warming, Shepherd says.

The stuck jet stream has kept Alaska on bake, with the town of Eagle hitting 91, the earliest Alaska has had a temperature pushing past 90, Masters says.

And on the other end of the country, New York; Boston; Hartford, Connecticut; Albany, New York; Providence, Rhode Island; and Concord, New Hampshire, all have received less than an inch of rain in May and are flirting with setting monthly records for drought, he says.

El Nino is known to change the weather worldwide, often making things more extreme. This El Nino is itself weird. It was long predicted but came far later and weaker than expected. So experts dialed back their forecasts. Then El Nino got stronger quickly.

Some scientists have theorized that the jet stream has been changing in recent years because of shrinking Arctic sea ice, an idea that has not totally been accepted but is gaining ground, Shepherd says.

Katharine Hayhoe, a climate scientist at Texas Tech University, likens what's happening to a stewpot: Natural climate fluctuations such as El Nino go into it. So do jet stream meanderings, random chance, May being a transition month, and local variability. Then throw in the direct and indirect effects of climate change. "We know that the stew has an extra ingredient," Hayhoe says, referring to climate change. "That ingredient is very strong. Sometimes you add one teaspoon of the wrong ingredient and boy, it can take your head off."

94. IMO Effort to Curb Ship Fires Seen as Possible Boost to Cleaner Fuels at Sea

The International Maritime Organization's adoption of a mandatory code for ships fueled by gases or other low-flashpoint fuels—a step taken to minimize the risk of onboard fires or explosions—could incidentally promote a quicker transition to cleaner global shipping, according to an industry official.

The International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels (IGF code) recently adopted in London is aimed at the growing number of ships that are using liquefied natural gas (LNG) or other gases in lieu of conventional fuel oil or marine diesel oil, the United Nations agency said in a June 16 briefing. But shipping officials said by making LNG-fueled ships safer, the directive could indirectly boost a speedier transition away from the relatively dirty fuel oil and marine diesel fuel, which are major contributors to the greenhouse gas emissions linked to shipping.

“It does help with the future rollout of LNG as an environmentally friendly fuel for ships,” said Simon Bennett, director of policy and external relations at the International Chamber of Shipping (ICS) in London.

Ships are under growing pressure to reduce emissions of sulfur oxide, which cause serious respiratory diseases, and the IMO agreed in 2008 to progressive reductions in both sulfur oxide and nitrogen oxide emissions from marine engines until 2020.

The London-based ICS comprises national ship owners' associations in Asia, Europe and the Americas whose member shipping companies operate more than 80 percent of the world's merchant tonnage.

The IMO's adoption of the IGF code came at the end of the Maritime Safety Committee's meeting in London from June 3–12 and included agreements on cybersecurity issues and new ships' routing.

The IGF code will apply to new and existing ships once the necessary amendments are made under the International Convention for the Safety of Life at Sea, which the IMO said it expected to be Jan. 1, 2017. The code contains mandatory provisions for the arrangement, installation, control and monitoring of machinery, equipment and systems using low-flashpoint fuels, focusing initially on LNG, the IMO said.

The measures are aimed at preventing the exposures of vapors with a flashpoint of less than 60 degrees Celsius (140 degrees Fahrenheit) to ignition, the ICS said. Flashpoint refers to the temperature at which a fuel can vaporize to form an ignitable mixture in air, according to Norway's DNV GL-Maritime, a service provider for managing risk in shipping and other industries.

The U.S., which has an abundant supply of natural gas, pushed for the adoption of the IGF code and for lowering the flashpoint, which currently is set at 60 degrees C, to 50 degrees C, to help reduce sulfur emissions, according to Bennett.

The 60-degree flashpoint remains, "although discussions about lowering it at a future point continue," IMO spokeswoman Natasha Brown said June 18.

At a June 4 meeting, the U.S. Federal Maritime Commission said, "natural gas, as a marine fuel, is strongly supported and endorsed by the Obama administration" and as this "fuel source is taking hold in the commercial U.S. domestic coastwise trade, it is now gaining traction in the inland waterway system and the international container trade."

95. Energy Subsidies at 16 Times Carbon Prices Stymie Pollution Curbs

Subsidies for fossil fuels are overwhelming efforts to curb pollution, the International Energy Agency said. Tax breaks, subsidized fuel prices and other government support amount to an incentive to pollute worth $115 per metric ton of carbon dioxide, the agency said June 15th in its Energy and Climate Change report. That compares with an average $7 cost to buy emission permits in carbon markets, according to the Paris-based group.

While Europe has moved to boost its emissions price and nations including India and Indonesia are cutting subsidies, countries have to make more ambitious pledges to limit heat-trapping gases, the IEA said. Fossil fuel support systems represent 13 percent of global emissions, compared with the 11 percent governed by carbon markets, according to the group.

"The price of fossil fuels are heavily subsidized around the world," Fatih Birol, IEA chief economist, said June 15th at a press conference in London. Group of 20 nations will likely reconsider curbing those incentives leading up to the Paris climate summit in December, he said.

Carbon dioxide emissions from energy use rose 0.5 percent to a record 35.5 billion tons last year, according to BP Plc data. Still, growth was the slowest since a drop in 2009, as Chinese coal consumption held steady. Under climate pledges delivered so far, the world's estimated remaining budget for curbing emissions will be consumed by about 2040, the IEA said.

That limit is consistent with a 50 percent chance of keeping the rise in temperature below 2 degrees, the agency said.

The test of success of climate talks in Paris Nov. 30–Dec. 11 will be "the conviction it conveys that governments are determined to act to the full extent necessary" to achieve the goal of keeping the rise in temperatures below 2 degrees Celsius (3.6 Fahrenheit) compared with a pre-industrial average, the IEA said.

Energy-related greenhouse gases will likely continue to rise after 2030 under a scenario that covers climate pledges made so far, said the adviser to 29 nations from the U.S. to Turkey.

Without stronger action before or after 2030, the world's path would be consistent with an average temperature increase of about 2.6 degrees by 2100 and 3.5 degrees after 2200, it said.

The global economy will likely expand by 88 percent from 2013 to 2030 and energy-related carbon dioxide emissions by 8 percent, according to the IEA. In North America, carbon prices and subsidies each cover about 4 percent of emissions, the agency said. The subsidies amount to $36 a ton on average, while the carbon price is $9 a ton. Latin American subsidies are $208 a ton compared with $173 a ton in the Middle East, $168 in Africa, $104 in India and $29 in China.

The subsidies are calculated as the ratio of the economic value of those fees to the carbon dioxide emissions released from the subsidized energy consumption, it said.

96. Emissions from Energy Show Slowest Gain since 2009 Drop, BP Says in Annual Review

Carbon dioxide emissions from energy use showed the slowest growth last year since a drop in 2009 as Chinese consumption of coal flattened, according to BP Plc. Output of the greenhouse gas from burning fossil fuels rose 0.5 percent from the previous year, London-based BP said June 10 in its annual Statistical Review of World Energy. That was the smallest increase for any year since 1998, with the exception of 2009, when emissions fell 1.5 percent, it said.

Chinese energy consumption rose 2.6 percent, the least since 1998, while nations in the Organization for Economic Cooperation and Development had a larger-than-average decline.

United Nations climate envoys meeting in Bonn June 1–11 sought to hone down a negotiation text for the world's first global climate accord to limit emissions. Repsol SA joined six other European oil companies June 9 in calling for governments to reach agreement on carbon pricing at a summit planned for later this year in Paris.

The slower growth of heat-trapping gases last year relative to the 10-year average stemmed largely from the changing pace and pattern of economic expansion in China, BP said in an e-mailed statement.

Renewable energy sources, in power generation and transportation, continued to increase in 2014 and reached a record 3 percent of global energy consumption, up from 0.9 percent a decade ago.

97. Solar-Powered Plane Due To Land in Hawaii after 5-Day Flight

An airplane powered by the sun is scheduled to land in Hawaii Friday after a five-day journey across the Pacific from Japan.

The flight is the longest leg of an around-the-world voyage planned by two Swiss pilots who have been taking turns flying the single-seat airplane. It is also the riskiest because the plane has nowhere to land in an emergency.

One of the pilots, Andre Borschberg, broke the record for the longest nonstop solo flight on the way to Hawaii, the team organizing the trip said. He shattered the previous record set by the late U.S. adventurer Steve Fossett, who flew around the world in 76 hours in a specially designed jet in 2006.

"Can you imagine that a solar-powered airplane without fuel can now fly longer than a jet plane?" Bertrand Piccard, the aircraft's other pilot, said in a statement. "This is a clear message that clean technologies can achieve impossible goals."

The plane is visiting Hawaii just as the state has embarked on its own ambitious clean energy project. Gov. David Ige last month signed legislation directing the state's utilities to generate 100 percent of their electricity from renewable energy resources by 2045. Hawaii's utilities currently get 21 percent of their power from renewable sources.

The aircraft is scheduled to land at a small airport outside Honolulu about 6 a.m. (9 a.m. PDT) Friday. Flight officials said the aircraft was arriving in the Hawaii area earlier but would fly in a holding pattern until the scheduled landing time.

Its next destination after leaving the islands is Phoenix, but the departure date hasn't been announced.

The plane began its global voyage in Abu Dhabi in March. It has stopped in Oman, India, Myanmar, China and Japan in the months since.

The wings of the carbon fiber aircraft have more than 17,000 solar cells. The plane flies up to about 28,000 feet during the day to recharge its batteries while descending to under 10,000 feet at night to minimize power consumption.

Bad weather is a challenge because the plane isn't designed to withstand rain, turbulence and heavy winds. Diverting around clouds takes extra energy.

The aircraft travels at about the same speeds as an automobile.

The pilots aim to demonstrate the potential of energy efficiency and renewable power with the project. Solar-powered air travel is not yet commercially practical though, given the slow travel time, weather and weight constraints of the aircraft.

To: Charmley, William[charmley.william@epa.gov]
From: International Council on Clean Transportation
Sent: Fri 1/30/2015 2:53:26 PM
Subject: Latest from the ICCT: Arctic shipping, Pacific Coast low-carbon fuels, the state of transport policy, airline fuel efficiency, and more

To: Nic Lutsey[nic@theicct.org]
From: Charmley, William
Sent: Tue 10/25/2016 4:33:20 PM
Subject: Re: Check in call on ICCT analysis

Nic

Can I call you on my drive home, say around 5:30pm east coast time?

Thanks
Bill

Sent from my iPhone

> On Oct 21, 2016, at 11:36 AM, Nic Lutsey <nic@theicct.org> wrote:
>
> Hi Bill,
>
> Great, thanks (and sorry for the delayed response…), I'm glad to give you our detailed thinking on timing etc. Please feel free to call me whenever today or Monday at 415-202-5743 (office) and Ex. 6 - Personal Privacy Ex. 6 - Personal Privacy (mobile). I've cc-ed JoNell, in case it's easier to pin down a 15 min slot in your calendar. Thanks in advance.
>
> Nic
>
>> On Oct 17, 2016, at 12:07 PM, Charmley, William <charmley.william@epa.gov> wrote:
>>
>> Nic -
>>
>>
>> Can I give you a call on this - I have a few background questions on the ICCT work, including timing, and then Mike can follow-up with you to discuss how we can help from a logistics perspective.
>>
>>
>> Thanks
>> Bill
>>
>>
>> -----Original Message-----
>> From: Nic Lutsey [mailto:nic@theicct.org]
>> Sent: Monday, October 17, 2016 2:41 PM
>> To: Charmley, William <charmley.william@epa.gov>; Olechiw, Michael <olechiw.michael@epa.gov>
>> Subject: Check in call on ICCT analysis
>>
>> Hi Mike and Bill,
>>
>> I hope all is going great for you two. Congrats on the great body of work you released with the TAR. I can't say I've read through everything, but I've probably read through more of it than most. The ICCT is chipping away a few projects, including John's tech briefing series — and now a new major analysis to report on technology potential for 2025-2030 for our global CO2 analysis.
>>
>> We think the best starting point for our 2025-2030 analysis is the TAR technology inputs, and the best modeling basis is to use the OMEGA platform. We wanted to reach out to try to schedule a short call to explain the project's approach and get input from your team on the use of the OMEGA modeling system. We are already well trained (we've worked with Ari over the years) and now have OMEGA 2016 up and

running. At this point, ensuring that any of our modified technology inputs run through the TEB-CEB machine, lumped parameter, etc for the OMEGA modeling is a key remaining question for us.
>>
>> Might we be able to schedule a call in the Oct 24-28, Oct 31- Nov 1 period? I think a call between our team and Mike, Todd, and others for 60 minutes would be extremely helpful to make sure we understand the final file preparation of OMEGA runs. Of course feel free to re-direct us to the applicable team members as you see fit. Here are my numbers if more context would help: 415-202-5743 (office) and Ex. 6 - Personal Privacy Ex. 6 - Personal Privacy (mobile).
>>
>> Nic
>

To: Moran, Robin[moran.robin@epa.gov]
From: Charmley, William
Sent: Mon 8/29/2016 7:34:15 PM
Subject: FW: Technology papers - Publication of Transmission Working Paper

Bill Charmley

Director

Assessment and Standards Division

Office of Transportation and Air Quality

U.S. Environmental Protection Agency

National Vehicle and Fuel Emissions Laboratory

2000 Traverwood Drive

Ann Arbor, MI 48105

desk ph. 734-214-4466

cell ph. 734-545-0333

e-mail: charmley.william@epa.gov

From: John German [mailto:john@theicct.org]
Sent: Monday, August 29, 2016 2:29 PM
To: Charmley, William <charmley.william@epa.gov>; Olechiw, Michael <olechiw.michael@epa.gov>; Alson, Jeff <alson.jeff@epa.gov>; Alberto@ARB Ayala <Alberto.Ayala@arb.ca.gov>; Mike McCarthy <michael.mccarthy@arb.ca.gov>
Cc: Anup Bandivadekar <anup@theicct.org>; NIc Lutsey <nic@theicct.org>; Joe Schultz <joe@theicct.org>; Aaron Isenstadt <aaron.isenstadt@theicct.org>
Subject: Re: Technology papers - Publication of Transmission Working Paper

FYI, we just published our second detailed technology working paper, this one on transmissions. Dana, BorgWarner, ITB, and FEV contributed to this paper:

http://www.theicct.org/PV-technology-transmissions-201608

Unfortunately, we have not yet finished ICCT's technology "brief" on transmissions, summarizing the results and adding a bit about implications on the mid-term review. I will let you know when this has been completed.

The papers on gasoline turbocharged engines and thermal management have finished supplier review and are now undergoing a final internal review by our communications team. The lightweighting paper was sent out for supplier review on Aug. 10, with their comments due by August 31. We are still hopeful that these can be finished by the end of September, with the paper on diesels following by the end of the year.

John

On Jun 21, 2016, at 10:51 AM, John German <john@theicct.org> wrote:

FYI, we just published two papers on naturally aspirated gasoline engines. These are the first in a series of technology reports in support of the 2017-25 mid-term review. Reports on transmissions, gasoline turbocharged engines, lightweighting, and thermal management will (hopefully) be finished by September, with a report on diesels following by the end of the year.

The first paper is the detailed working paper that we did in collaboration with Eaton, BorgWarner, and ITB.

Working paper: <http://theicct.org/naturally-aspirated-gas-engines-201606>

The second is ICCT's technology "brief", which summarizes the results of the working paper and adds a bit about implications on the mid-term review.
Tech brief: <http://theicct.org/naturally-aspirated-engines-techbrief-jun2016>

Let me know if you have any questions or want additional information.

John

To: John German[john@theicct.org]
From: Charmley, William
Sent: Tue 5/24/2016 5:53:12 PM
Subject: RE: I left you a voice-mail

John,

I have spoken with Chet, Siddiq and Davd – they are all available tomorrow morning at 9:30.

Can you host this meeting at ICCT? I think it would just be the 5 of us.

Thanks

Bill

From: John German [mailto:john@theicct.org]
Sent: Tuesday, May 24, 2016 1:15 PM
To: Charmley, William <charmley.william@epa.gov>
Subject: Re: I left you a voice-mail

Yes, I am available at 9:30 tomorrow.

I in a call now, but I will call you when I get a chance.

John

On May 24, 2016, at 1:12 PM, Charmley, William <charmley.william@epa.gov> wrote:

Regarding tomorrow in D.C.

I will be in DC tomorrow, and from 10:30-12:30 I will be at ICCT for a meeting with Drew

Are you available in the morning, say from 9:30 – 10:30, to catch up on some light-duty MTE topics? If yes, I might invite Chet France from EDF, Siddiq from ACEEE, and Dave Cook from UCS to the ICCT offices for a discussion along with you on the MTE.

Please give me a call if you have a few minutes at 734-214-4466.

Thanks

Bill

To: John German[john@theicct.org]
From: Charmley, William
Sent: Tue 5/24/2016 5:12:26 PM
Subject: I left you a voice-mail

Regarding tomorrow in D.C.

I will be in DC tomorrow, and from 10:30-12:30 I will be at ICCT for a meeting with Drew

Are you available in the morning, say from 9:30 – 10:30, to catch up on some light-duty MTE topics? If yes, I might invite Chet France from EDF, Siddiq from ACEEE, and Dave Cook from UCS to the ICCT offices for a discussion along with you on the MTE.

Please give me a call if you have a few minutes at 734-214-4466.

Thanks

Bill

To: Jonna Hamilton[JHamilton@ucsusa.org]; Ayala, Alberto@ARB[Alberto.Ayala@arb.ca.gov]
From: Charmley, William
Sent: Mon 5/23/2016 5:13:02 PM
Subject: RE: Meeting: TAR Mid-Term Evaluation

Alberto –

I'm also on the line from Ann Arbor, listening to this great music.

From: Jonna Hamilton [mailto:JHamilton@ucsusa.org]
Sent: Monday, May 23, 2016 1:11 PM
To: Ayala, Alberto@ARB <Alberto.Ayala@arb.ca.gov>
Cc: blair.anderson@dot.gov; McCabe, Janet <McCabe.Janet@epa.gov>; Atkinson, Emily <Atkinson.Emily@epa.gov>; Zavala, Carolina@ARB <carolina.zavala@arb.ca.gov>; Grundler, Christopher <grundler.christopher@epa.gov>; Hengst, Benjamin <Hengst.Benjamin@epa.gov>; Charmley, William <charmley.william@epa.gov>; Solomon, Raquel@ARB <raquel.solomon@arb.ca.gov>; McCarthy, Mike@ARB <michael.mccarthy@arb.ca.gov>; Hebert, Annette@ARB <annette.hebert@arb.ca.gov>; Bevan, Analisa@ARB <analisa.bevan@arb.ca.gov>
Subject: Re: Meeting: TAR Mid-Term Evaluation

The NGOs and EPA are almost through security and will be up to get on the phone very soon.

Sent from my iPhone

On May 23, 2016, at 1:09 PM, Ayala, Alberto@ARB <Alberto.Ayala@arb.ca.gov> wrote:

> Hello,
>
> Is this call still on? I am on the line.
>
> -Alberto
>
> ---
>
> Alberto Ayala, PhD, MSE

Deputy Executive Officer

CALIFORNIA AIR RESOURCES BOARD

1001 I Street, Sacramento, CA 95812

916.322.2892 (direct)

916.445.4383 (Exec. Office line)

Alberto.Ayala@arb.ca.gov

-----Original Appointment-----
From: heather.laca@dot.gov [mailto:heather.laca@dot.gov] **On Behalf Of** blair.anderson@dot.gov
Sent: Thursday, May 05, 2016 8:36 AM
To: blair.anderson@dot.gov; McCabe.Janet@epa.gov; Atkinson.Emily@epa.gov; JHamilton@ucsusa.org; Zavala, Carolina@ARB; grundler.christopher@epa.gov; Hengst.Benjamin@epa.gov; charmley.william@epa.gov; Ayala, Alberto@ARB; Solomon, Raquel@ARB; McCarthy, Mike@ARB; Corey, Richard@ARB; Hebert, Annette@ARB; Bevan, Analisa@ARB; Zavala, Carolina@ARB
Subject: Meeting: TAR Mid-Term Evaluation
When: Monday, May 23, 2016 1:00 PM-2:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: DOT HQ - W40-300 - 1200 New Jersey Avenue, SE, Washington, DC 20590

If you need to call into this meeting please use the call-in number below

Ex. 6 - Personal Privacy

Please be sure that all members of your group have their US Government Issued ID to clear security. Upon arrival please call 202-366-2775 and I will escort you to the conference room once your have cleared security.

Thank you

Heather Laca

Administrative Staff Assistant

Department Of Transportation

National Highway Traffic Safety Administration

1200 New Jersey Avenue, SE, W40-304

Washington, DC 20590

Office – 202-366-2775

From: Jonna Hamilton [mailto:JHamilton@ucsusa.org]
Sent: Wednesday, April 27, 2016 2:17 PM
To: mccabe.janet@epa.gov; mark.rosekind@dot.gov; Corey, Richard@ARB
Cc: Atkinson.emily@epa.gov; hengst.benjamin@epa.gov; yvonne.e.clarke@dot.gov; Ayala, Alberto@ARB
Subject: Meeting request

Dear Assistant Administrator McCabe, Administrator Rosekind, and Mr. Corey,

On behalf of the NGO communities that represent environmental organizations, consumer groups, national security groups, and business groups, I would like to request a meeting in May to discuss the mid-term evaluation and specifically the upcoming Technical Assessment Report (TAR) that is due out in June of this year. Our organizations would like to learn more about your approach to the mid-term evaluation process and the TAR and share our view on the mid-term evaluation as well as preview some additional analysis that we are working on.

We look forward to talking with you.

Thank you,

Jonna Hamilton

Jonna Hamilton

Senior Washington Representative

Clean Vehicles Program

Union of Concerned Scientists

1825 K Street NW, Suite 800

Washington, DC 20001

202-331-5451

JHamilton@ucsusa.org

To: Peter Mock[peter@theicct.org]
Cc: Lutsey NIc[nic@theicct.org]; Drew Kodjak[drew@theicct.org]
From: Charmley, William
Sent: Wed 1/27/2016 5:54:39 PM
Subject: RE: ICCT expert regarding the status of the EU light-duty vehicle 2020 and 2025 CO2 targets

Dear Peter,

Thank you so much for this information, this is exactly what I was looking for. I will take a closer look over the next week.

Best regards,

Bill

Bill Charmley
Director
Assessment and Standards Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

National Vehicle and Fuel Emissions Laboratory
2000 Traverwood Drive
Ann Arbor, MI 48105

desk ph. 734-214-4466
cell ph. 734-545-0333
e-mail: charmley.william@epa.gov

-----Original Message-----
From: Peter Mock [mailto:peter@theicct.org]
Sent: Wednesday, January 27, 2016 12:24 PM
To: Charmley, William
Cc: Lutsey NIc; Drew Kodjak
Subject: Re: ICCT expert regarding the status of the EU light-duty vehicle 2020 and 2025 CO2 targets

Dear Bill,

The CO2 standards for 2020 were adopted end of 2014. The 95 g/km target for passenger cars applies for 2021, the 147 g/km target for light-commercial vehicles for 2020. The standards are based on vehicle weight. There are some provisions for EVs (called 'super-credits'). You can find a summary of the 2020/21 standards here:
http://theicct.org/eu-co2-standards-passenger-cars-and-lcvs

Keep in mind that all targets are based on the NEDC testing procedure. The real-world CO2 emissions are about 40% higher.
http://www.theicct.org/laboratory-road-2015-update
It is planned to introduce the WLTP in the EU from Sep 2017 onwards. With the introduction of the WLTP, the 2020/21 targets will be adjusted upwards to reflect that the WLTP is supposedly more realistic/stringent. The final NEDC/WLTP correlation procedure is not finalized yet but it looks like there might be a substantial weakening of the standards.

For the post-2020 CO2 standards, the preparations are ongoing. The Environment Committee of the European Parliament originally suggested a corridor of 68-78 g/km (based on NEDC). The European Commission has tasked the consultancy Ricardo-AEA to carry out an assessment of vehicle technology potential and costs. The study has been completed but is not published yet (a draft was presented at a stakeholder meeting in summer 2015). I tried to put the various cost curve studies into perspective in this blog:
http://theicct.org/blogs/staff/estimating-costs-vehicle-efficiency-lessons-experience
The Commission is now working on an Impact Assessment. It is expected that in spring 2016 there will be a "Communication", announcing that the Commission will come forward with a proposal for LDV CO2 standards (whether for 2025 or 2030 or both target years is uncertain at this point). The actual regulatory proposal is not expected until end-2016/early-2017.

ICCT is currently also working on out own post-2020 EU cost curve study. For this we have tasked FEV to carry out vehicle simulations and bottom-up cost estimates. FEV has delivered the draft final report to us in Nov 2015 and we are currently in discussion with them, hoping to receive a final report within the next weeks. In parallel we have started developing our own cost curves based on the FEV results as well as other sources.

I hope this information is useful for you. Please do not hesitate to follow-up with any questions you might have.

Best,

Peter

Dr. Peter Mock
Managing Director ICCT Europe
Neue Promenade 6, 10178 Berlin
+49 (30) 847129-102
peter@theicct.org

http://www.theicct.org
http://www.transportpolicy.net
http://eupocketbook.theicct.org

ICCT - International Council on Clean Transportation Europe gemeinnuetzige GmbH Managing Director:
Dr. Peter Mock, Amtsgericht Charlottenburg HRB 143557, VAT-IdNr. DE284186076

> On 26 Jan 2016, at 23:05, Drew Kodjak <drew@theicct.org> wrote:
>
> Hi Bill,
>
> We briefed Chris and Karl up on the compliance and enforcement status in Europe last week.
>
> Happy to do the same for you.
>
> In the interim, I'm copying Peter Mock, who can give you the current status of the CO2 standards post 2020.
>
> Warm regards,
>
> Drew
>

>
>
>
> On Jan 26, 2016, at 5:01 PM, Charmley, William <charmley.william@epa.gov> wrote:
>
> Dear Drew and Nic
>
>
> In the next few days I need to come up to speed regarding what is the status within Europe of the LDV CO2 standards.
>
>
> I know a few years ago they were discussing a 2020 target of 95 g/km, and then a goal of perhaps 65 g/km in 2025.
>
>
> Can you either point me to an ICCT document or blog, or let me know who I can talk to, to get the current lay of the land?
>
>
> Next week Chris, Karl Simon, Jim Blubaugh and I will be in Brussels and I would like do some home work in advance.
>
> Thanks
> Bill

To: John German[john@theicct.org]
From: Charmley, William
Sent: Fri 8/21/2015 4:26:31 PM
Subject: RE: ICCT response to NRC CAFE report

John,

I was just reflecting back on this email sent in June in light of your Asilomar presentation comments on mass reduction.

It is disappointing if you provided comments on the report that were largely ignored. I thought you were on the engineering review board for NRC – seems like something the academy should do something about.

It is also too bad on the transparency part. For most reports that EPA has peer reviewed, we have to document the entire process, including the response to the peer review comments. It doesn't sound like that is part of the NAS/NRC process.

Thanks

Bill

From: John German [mailto:john@theicct.org]
Sent: Thursday, June 25, 2015 10:46 AM
To: Charmley, William
Cc: Olechiw, Michael; Nam, Ed; Alson, Jeff; Moran, Robin; Anup Bandivadekar; NIc Lutsey; Drew Kodjak; Joe Schultz
Subject: Re: ICCT response to NRC CAFE report

Thanks for the feedback, Bill! It is much appreciated.

I had a head start, as I was one of the peer reviewers for the report. Not that they paid much attention to my 20+ pages of comments - they ignored almost all of them in the final report.

Re Roland's charts. I have been resistant to even acknowledging the NRC 2011 report. This is because the report clearly states, in the summary and again in the introduction, that it constrained the applicability of its technology and cost data to the very near term, e.g.:

- "Tables S-1 and S-2 show the committee's estimates of fuel consumption benefits and costs for technologies that are commercially available and can be implemented within 5 years. The cost estimates represent estimates for the current (2009/2010) time period to about 5 years in the future." [NAS report page S-1]
- "Again,except where indicated otherwise, the cost estimates provided are based on current conditions and do not attempt to estimate economic conditions and hence predict prices 5, 10, or 15 years into the future." [NAS report page S6]
- "The cost estimates represent estimates for the current (2009/2010) time period to about 5 years in the future." [NAS report page 9-8]

The report is very clear that It's not applicable to 2025 and, thus, I don't think it should be quoted in that context.

Re costs from the 2002 NRC report. Your suggestion to use midsize car compliance is not straightforward, as this report was pre-footprint adjustment. Thus, there are no target values for a midsize car. The closest they came was a table showing the mpg and cost for a 14-year payback by vehicle class. The midsize car increased from a 1999 baseline of 27.1 mpg (26.2 after adding weight for future safety compliance) to 32.6 mpg (+20%) at a cost of $791 (midrange case). But 20% is only about half the increase from 1999 to 2016.

They did publish cost curves for cars and light trucks:

To: Ellies, Ben[ellies.ben@epa.gov]
Cc: Rebecca Dilger[rebecca.dilger@gmail.com]; barbarac@uga.edu[barbarac@uga.edu]
From: Rachel Silva
Sent: Thur 2/26/2015 2:31:12 PM
Subject: Re: FW: Oliver Schmidt of VW touting the virtues of US (vs. Europe) regulatory process

Ben- **Ex. 6 - Personal Privacy** Would you say this is a shift and that perhaps euro countries used to have better standards than US?
How many of you are at EPA Ann Arbor office?

Ex. 6 - Personal Privacy

On Thursday, February 26, 2015, Ellies, Ben <ellies.ben@epa.gov> wrote:

Ex. 6 - Personal Privacy

From: Rebecca Dilger [mailto:rebecca.dilger@gmail.com]
Sent: Thursday, February 26, 2015 9:02 AM
To: Ellies, Ben
Cc: barbarac@uga.edu; Rachel Silva
Subject: Re: FW: Oliver Schmidt of VW touting the virtues of US (vs. Europe) regulatory process

Ex. 6 - Personal Privacy

On Tue, Feb 24, 2015 at 4:16 PM, Ellies, Ben <ellies.ben@epa.gov> wrote:

Here's a nice sound byte about what we do here in our Ann Arbor office.

There is a video clip, fast forward to about the 5 min mark. This VP from Volkswagen is saying that the US emissions standards are better than the rest of the world's…

http://www.autoline.tv/journal/?p=36071

Ex. 6 - Personal Privacy

Ben

From: Moran, Robin
Sent: Tuesday, February 24, 2015 10:08 AM
To: Midterm Review
Subject: Oliver Schmidt of VW touting the virtues of US (vs. Europe) regulatory process

This is an uplifting clip (around 6 minutes in) of VW's Oliver Schmidt praising the superiority of US regulations because they're written by "technical experts (in Ann Arbor)" vs. Europe's process led by politicians. Also talks about the US regs' "solid foundation" and looking out into the future.

From: Carol Lee Rawn [mailto:rawn@ceres.org]
Sent: Monday, February 23, 2015 3:32 PM
To: Moran, Robin
Subject: Fwd: Virtues in US fuel economy standards

Hi Robin - this was forwarded to me - thought you might be interested in hearing about the superiority of the US regulatory process!

Best, Carol Lee

Please listen to this clip starting at 5 minute mark.

http://www.autoline.tv/journal/?p=36071

That was Oliver Schmidt, the powertrain guy at VW NA (who is going back to Europe shortly).

Alan

--

Alan Baum
Principal
Baum and Associates
248-202-2629
www.baum-assoc.com
abaumcons@gmail.com

Carol Lee Rawn

Director, Transportation Program

Ceres

99 Chauncy Street

Boston, MA 02111-1703

(T) 617-247-0700 ext. 112

(M) 617-388-7879

www.ceres.org

To: Rebecca Dilger[rebecca.dilger@gmail.com]; Ellies, Ben[ellies.ben@epa.gov]
Cc: Rachel Silva[silva.rachel.e@gmail.com]
From: Barbara A Crawford
Sent: Thur 2/26/2015 2:03:54 PM
Subject: Re: FW: Oliver Schmidt of VW touting the virtues of US (vs. Europe) regulatory process

Ex. 6 - Personal Privacy

Barbara A. Crawford, Ph. D.
Department Head and Professor
Department of Mathematics and Science Education
The University of Georgia
104C Aderhold Hall
Athens GA 30602

Phone: 706.542.4548
Fax: 706.542.4551

PI: Fossil Finders: Using Fossils to Teach about Evolution, Inquiry and Nature of Science
Associate Editor, Journal of Science Teacher Education

From: Rebecca Dilger <rebecca.dilger@gmail.com>
Sent: Thursday, February 26, 2015 9:01 AM
To: Ellies, Ben
Cc: Barbara A Crawford; Rachel Silva
Subject: Re: FW: Oliver Schmidt of VW touting the virtues of US (vs. Europe) regulatory process

Ex. 6 - Personal Privacy

On Tue, Feb 24, 2015 at 4:16 PM, Ellies, Ben <ellies.ben@epa.gov> wrote:

Here's a nice sound byte about what we do here in our Ann Arbor office.

There is a video clip, fast forward to about the 5 min mark. This VP from Volkswagen is saying that the US emissions standards are better than the rest of the world's...

http://www.autoline.tv/journal/?p=36071

Ex. 6 - Personal Privacy

Ben

From: Moran, Robin
Sent: Tuesday, February 24, 2015 10:08 AM
To: Midterm Review
Subject: Oliver Schmidt of VW touting the virtues of US (vs. Europe) regulatory process

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To: Ellies, Ben[ellies.ben@epa.gov]
Cc: barbarac@uga.edu[barbarac@uga.edu]; Rachel Silva[silva.rachel.e@gmail.com]
From: Rebecca Dilger
Sent: Thur 2/26/2015 2:01:31 PM
Subject: Re: FW: Oliver Schmidt of VW touting the virtues of US (vs. Europe) regulatory process

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(M) 617-388-7879

www.ceres.org

To: Ellies, Ben[ellies.ben@epa.gov]
From: Barbara A Crawford
Sent: Tue 2/24/2015 9:28:48 PM
Subject: Re: Oliver Schmidt of VW touting the virtues of US (vs. Europe) regulatory process

Ex. 6 - Personal Privacy

Barbara A. Crawford, Ph. D.
Department Head and Professor
Department of Mathematics and Science Education
The University of Georgia
104C Aderhold Hall
Athens GA 30602

Phone: 706.542.4548
Fax: 706.542.4551

PI: Fossil Finders: Using Fossils to Teach about Evolution, Inquiry and Nature of Science
Associate Editor, Journal of Science Teacher Education

From: Ellies, Ben <ellies.ben@epa.gov>
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To: Rebecca Dilger[rebecca.dilger@gmail.com]
Cc: barbarac@uga.edu[barbarac@uga.edu]; Rachel Silva[silva.rachel.e@gmail.com]
From: Ellies, Ben
Sent: Thur 2/26/2015 2:16:06 PM
Subject: RE: FW: Oliver Schmidt of VW touting the virtues of US (vs. Europe) regulatory process

Ex. 6 - Personal Privacy

From: Rebecca Dilger [mailto:rebecca.dilger@gmail.com]
Sent: Thursday, February 26, 2015 9:02 AM
To: Ellies, Ben
Cc: barbarac@uga.edu; Rachel Silva
Subject: Re: FW: Oliver Schmidt of VW touting the virtues of US (vs. Europe) regulatory process

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To: barbarac@uga.edu[barbarac@uga.edu]; Rachel Silva[silva.rachel.e@gmail.com]; rebecca.dilger@gmail.com[rebecca.dilger@gmail.com]
From: Ellies, Ben
Sent: Tue 2/24/2015 9:16:03 PM
Subject: FW: Oliver Schmidt of VW touting the virtues of US (vs. Europe) regulatory process

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(M) 617-388-7879

www.ceres.org

From: heather.laca@dot.gov
Location: DOT HQ - W40-300 - 1200 New Jersey Avenue, SE, Washington, DC 20590
Importance: Normal
Subject: Meeting: TAR Mid-Term Evaluation
Start Date/Time: Mon 5/23/2016 5:00:00 PM
End Date/Time: Mon 5/23/2016 6:00:00 PM

...
,,,
If you need to call into this meeting please use the call-in number below

Ex. 6 - Personal Privacy

Please be sure that all members of your group have their US Government Issued ID to clear security. Upon arrival please call 202-366-2775 and I will escort you to the conference room once your have cleared security.
Thank you

Heather Laca
Administrative Staff Assistant
Department Of Transportation
National Highway Traffic Safety Administration
1200 New Jersey Avenue, SE, W40-304
Washington, DC 20590
Office – 202-366-2775

From: Jonna Hamilton [mailto:JHamilton@ucsusa.org]
Sent: Wednesday, April 27, 2016 2:17 PM
To: mccabe.janet@epa.gov; mark.rosekind@dot.gov; Corey, Richard@ARB
Cc: Atkinson.emily@epa.gov; hengst.benjamin@epa.gov; yvonne.e.clarke@dot.gov; Ayala, Alberto@ARB
Subject: Meeting request

Dear Assistant Administrator McCabe, Administrator Rosekind, and Mr. Corey,
On behalf of the NGO communities that represent environmental organizations, consumer groups, national security groups, and business groups, I would like to request a meeting in May to discuss the mid-term evaluation and specifically the upcoming Technical Assessment Report (TAR) that is due out in June of this year. Our organizations would like to learn more about your approach to the mid-term evaluation process and the TAR and share our view on the mid-term evaluation as well as preview some additional analysis that we are working on.
We look forward to talking with you.
Thank you,
Jonna Hamilton

Jonna Hamilton
Senior Washington Representative
Clean Vehicles Program
Union of Concerned Scientists
1825 K Street NW, Suite 800
Washington, DC 20001
202-331-5451
JHamilton@ucsusa.org

To: Drew Kodjak[drew@theicct.org]
From: Atkinson, Emily
Sent: Mon 5/23/2016 6:13:57 PM
Subject: Confirmed 5/25 at 4:30pm: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation

Great Drew, so you are confirmed for a 45 minute meeting Wednesday, May 25 at 4:30pm with Janet McCabe.

Directions and procedures to 1200 Pennsylvania Avenue NW:

Metro: If you come by Metro get off at the Federal Triangle metro stop. Exit the metro station and go up two sets of escalators to the surface level and turn right. You will see a short staircase and wheelchair ramp leading to a set of glass doors with the EPA logo - that is the William Jefferson Clinton Federal Building, North Entrance.

Taxi: Direct the taxi to drop you off on 12th Street NW, between Constitution and Pennsylvania Avenues, at the elevator for the Federal Triangle metro stop - this is almost exactly half way between the two avenues on 12th Street NW. Facing the building with the EPA logo and American flags, walk toward the building and take the glass door on your right hand side with the escalators going down to the metro on your left – that is the North Lobby of the William Jefferson Clinton building.

Security Procedures: A government issued photo id is required to enter the building and it is suggested you arrive 15 minutes early in order to be cleared and arrive at the meeting room on time. Upon entering the lobby, the meeting attendees will be asked to pass through security and provide a photo ID for entrance. Let the guards know that you were instructed to call 202-564-7404 for a security escort.

Please send me a list of participants in advance of the meeting and feel free to contact me should you need any additional information.

Emily

Emily Atkinson
Staff Assistant

Immediate Office of the Acting Assistant Administrator
Office of Air and Radiation, USEPA
Room 5406B, 1200 Pennsylvania Avenue NW
Washington, DC 20460
Voice: 202-564-1850

Email: atkinson.emily@epa.gov

From: Drew Kodjak [mailto:drew@theicct.org]
Sent: Monday, May 23, 2016 1:58 PM
To: Atkinson, Emily <Atkinson.Emily@epa.gov>
Subject: Re: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation

Yes, confirmed.

I'll send you a full list of attendees tomorrow.

Crashing on board materials today.

Thanks

On May 23, 2016, at 1:51 PM, Atkinson, Emily <Atkinson.Emily@epa.gov> wrote:

Hi Drew,

Just want to circle back to see if you all would like to confirmed Wednesday, May 25 at 4:30pm?

Emily Atkinson
Staff Assistant

Immediate Office of the Acting Assistant Administrator
Office of Air and Radiation, USEPA
Room 5406B, 1200 Pennsylvania Avenue NW
Washington, DC 20460
Voice: 202-564-1850
Email: atkinson.emily@epa.gov

From: Atkinson, Emily
Sent: Friday, May 20, 2016 11:48 AM
To: Drew Kodjak <drew@theicct.org>
Subject: RE: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation

Yes, I apologize it is Wednesday, May 25 at 4:30pm.

Emily Atkinson
Staff Assistant

Immediate Office of the Acting Assistant Administrator
Office of Air and Radiation, USEPA
Room 5406B, 1200 Pennsylvania Avenue NW
Washington, DC 20460
Voice: 202-564-1850
Email: atkinson.emily@epa.gov

From: Drew Kodjak [mailto:drew@theicct.org]
Sent: Friday, May 20, 2016 11:43 AM
To: Atkinson, Emily <Atkinson.Emily@epa.gov>
Subject: Re: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation

Hi Emily.

Please hold the date and time as I check with others. It's Wednesday correct?

Sent from my iPhone

On May 20, 2016, at 9:32 AM, Atkinson, Emily <Atkinson.Emily@epa.gov> wrote:

Hi Drew,

Just want to circle back on this. Let me know if a 45 minute meeting on Tuesday, May 25 at 4:30pm ET works for you all.

Thank you.

Emily

Emily Atkinson
Staff Assistant

Immediate Office of the Acting Assistant Administrator
Office of Air and Radiation, USEPA
Room 5406B, 1200 Pennsylvania Avenue NW
Washington, DC 20460
Voice: 202-564-1850
Email: atkinson.emily@epa.gov

From: Atkinson, Emily
Sent: Wednesday, May 18, 2016 10:22 AM
To: Drew Kodjak <drew@theicct.org>
Subject: RE: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation

Hi Drew,

It looks like we could fit this in as a 45 minute meeting on Tuesday, May 25 at 4:30pm ET. I have this spot on hold so let me know when you return on Friday what works best on your end.

Thank you.

Emily

Emily Atkinson
Staff Assistant

Immediate Office of the Acting Assistant Administrator
Office of Air and Radiation, USEPA
Room 5406B, 1200 Pennsylvania Avenue NW
Washington, DC 20460
Voice: 202-564-1850
Email: atkinson.emily@epa.gov

From: Drew Kodjak [mailto:drew@theicct.org]
Sent: Wednesday, May 18, 2016 3:18 AM
To: Atkinson, Emily <Atkinson.Emily@epa.gov>
Subject: Re: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation

Thanks Emily,

I'm in China at the moment, but I will follow up with you when I'm back in the States on Friday.

It would be useful to get a sense of Janet's availability before going back to my colleagues at major environmental organizations.

Talk soon

Drew

On May 18, 2016, at 3:52 AM, Atkinson, Emily <Atkinson.Emily@epa.gov> wrote:

Hi Drew,

Janet McCabe has reviewed this meeting request and would be happy for me to arrange a 45 minute meeting that would include Chris Grundler and OTAQ staff.

Let me know if you have a preferred date/time and I can work to fit this into Janet's schedule.

Emily

Emily Atkinson
Staff Assistant

Immediate Office of the Acting Assistant Administrator
Office of Air and Radiation, USEPA
Room 5406B, 1200 Pennsylvania Avenue NW
Washington, DC 20460
Voice: 202-564-1850
Email: atkinson.emily@epa.gov

From: Azoolin, Liel
Sent: Friday, May 13, 2016 3:10 PM
To: Drew Kodjak <drew@theicct.org>
Cc: Atkinson, Emily <Atkinson.Emily@epa.gov>
Subject: RE: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation

Hi Drew,

Thank you again for the request to meet with Administrator McCarthy on either May 24 or May 25.

We regret to inform you that unfortunately the Administrator's schedule will not be able to accommodate this meeting at this time.

However, we can offer a meeting with Janet McCabe, Assistant Administrator in the Office of Air and Radiation. I've looped in Emily Atkinson (cc'd above), so you may coordinate directly with her in scheduling this meeting.

Thank you,

Liel

From: Drew Kodjak [mailto:drew@theicct.org]
Sent: Tuesday, May 03, 2016 2:03 PM
To: Azoolin, Liel <Azoolin.Liel@epa.gov>
Cc: scheduling <scheduling@epa.gov>; McCabe, Janet <McCabe.Janet@epa.gov>; Grundler, Christopher <grundler.christopher@epa.gov>
Subject: Re: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation

Hi Azoolin,

Once we have the meeting scheduled, I expect to invite a couple additional representatives from major US environmental organizations: NRDC, EDF, Sierra Club, ACEEE.

Warm regards,

Drew

On May 3, 2016, at 9:59 AM, Azoolin, Liel <Azoolin.Liel@epa.gov> wrote:

Hi Drew,

I apologize for the delayed response to your request. We are still working out the Administrator's schedule for the last week of May.

Would the meeting participants just be Ms. Oge and Mr. Kimmel or would anyone else like to join the meeting?

I will be in touch as soon as a determination of the Administrator's available has been made.

Please do not hesitate to reach out if you have any questions.

Thank you,

Liel

From: Drew Kodjak [mailto:drew@theicct.org]
Sent: Tuesday, May 03, 2016 8:10 AM
To: Azoolin, Liel <Azoolin.Liel@epa.gov>
Cc: McCabe, Janet <McCabe.Janet@epa.gov>; Grundler, Christopher <grundler.christopher@epa.gov>
Subject: Fwd: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation

Dear Ms. Azoolin, with copies to Assistant Administrator McCabe and Office Director Grundler,

I sent in a meeting request to visit with Administrator McCarthy ten days ago and have not yet received a response. I know these are busy times for the Agency, so I wanted to send this note again to move my request to the top of your inbox. Please see the note below.

With warm regards,

Drew Kodjak

Executive Director

International Council on Clean Transportation

Begin forwarded message:

From: "Drew Kodjak" <drew@theicct.org>

Subject: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation

Date: April 21, 2016 at 11:29:24 AM EDT

To: azoolin.liel@epa.gov

Cc: margo.oge@gmail.com, "Jonna Hamilton" <jhamilton@ucsusa.org>, "Alexandra Herrera" <alex.herrera@theicct.org>

Dear Ms. Azoolin,

My name is Drew Kodjak. I'm the executive director of the International Council on Clean Transportation. My organization works with governments in the world's top vehicle markets to support policies to reduce air pollution and climate change emissions from vehicles and fuels.

I'm writing today on behalf of Margo Oge, former office director of EPA's Office of Transportation and Air Quality, and Ken Kimmel, executive director of the Union of Concerned Scientists. We'd like to request a meeting with Administrator McCarthy to discuss the critically important mid-term evaluation of the 54.5 mpg regulations.

The United States is the global leader in this area. Its continued leadership is essential if the world is to achieve its global ambitions to reach our climate change goals proposed last year in Paris. The Obama Administration was instrumental in paving the way for last year's climate deal, and effective implementation of climate policies will demonstrate continued commitment.

One of the cornerstones of US climate policy is the light-duty vehicle fuel economy standards established from 2017 to 2025, commonly referred to as the 54.5 mpg regulations. These regulations are expected to double passenger vehicle fuel economy from 2010 to 2025, although this depends on the outcome of the mid-term evaluation. While some nations have more efficient fleets than the United States, no other nation has developed such appropriately ambitious policies.

We would like to share with the Administrator our perspectives on the importance of these standards, why we believe that these standards are cost effective even in light of today's low gasoline prices, and how these standards are necessary but not sufficient for driving transformational change in the automotive industry towards electric drive.

We have some available dates at the end of May: specifically May 24th in the morning; and May 25th in the afternoon after 2:30. Would you please let me know if either of these dates would work? If these dates do not work, would you please share with us some alternative dates and times that might work for the Administrator?

With warm regards,

Drew Kodjak

Executive Director

International Council on Clean Transportation

202-285-3672

To: Atkinson, Emily[Atkinson.Emily@epa.gov]
From: Drew Kodjak
Sent: Tue 5/24/2016 4:41:55 PM
Subject: Re: Confirmed 5/25 at 4:30pm: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation

Hi Emily
Here's the list of attendees.

ICCT - myself and John German
UCS - Ken Kimmel
NRDC - Roland Hwang, Luke Tonachel
EDF - Vicki Patton, Chet France
ACEEE - Siddiq Khan

Look forward to it

Drew

On May 24, 2016, at 11:36 AM, Atkinson, Emily <Atkinson.Emily@epa.gov> wrote:

Hi Drew,

Just following up for the list of participants for tomorrow's meeting with Janet McCabe. If you could send them to me by COB today, it would be appreciated.

Thank you.
Emily

Emily Atkinson
Staff Assistant
Immediate Office of the Acting Assistant Administrator
Office of Air and Radiation, USEPA
Room 5406B, 1200 Pennsylvania Avenue NW
Washington, DC 20460
Voice: 202-564-1850
Email: atkinson.emily@epa.gov

From: Atkinson, Emily
Sent: Monday, May 23, 2016 2:14 PM
To: Drew Kodjak <drew@theicct.org>

Subject: Confirmed 5/25 at 4:30pm: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation

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Washington, DC 20460
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Email: atkinson.emily@epa.gov

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Sent: Monday, May 23, 2016 1:58 PM
To: Atkinson, Emily <Atkinson.Emily@epa.gov>
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Staff Assistant
Immediate Office of the Acting Assistant Administrator
Office of Air and Radiation, USEPA
Room 5406B, 1200 Pennsylvania Avenue NW
Washington, DC 20460
Voice: 202-564-1850
Email: atkinson.emily@epa.gov

From: Atkinson, Emily
Sent: Friday, May 20, 2016 11:48 AM
To: Drew Kodjak <drew@theicct.org>
Subject: RE: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation

Yes, I apologize it is Wednesday, May 25 at 4:30pm.

Emily Atkinson
Staff Assistant
Immediate Office of the Acting Assistant Administrator
Office of Air and Radiation, USEPA
Room 5406B, 1200 Pennsylvania Avenue NW
Washington, DC 20460
Voice: 202-564-1850
Email: atkinson.emily@epa.gov

From: Drew Kodjak [mailto:drew@theicct.org]
Sent: Friday, May 20, 2016 11:43 AM

To: Atkinson, Emily <Atkinson.Emily@epa.gov>
Subject: Re: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation

Hi Emily.

Please hold the date and time as I check with others. It's Wednesday correct?

Sent from my iPhone

On May 20, 2016, at 9:32 AM, Atkinson, Emily <Atkinson.Emily@epa.gov> wrote:

Hi Drew,

Just want to circle back on this. Let me know if a 45 minute meeting on Tuesday, May 25 at 4:30pm ET works for you all.

Thank you.
Emily

Emily Atkinson
Staff Assistant
Immediate Office of the Acting Assistant Administrator
Office of Air and Radiation, USEPA
Room 5406B, 1200 Pennsylvania Avenue NW
Washington, DC 20460
Voice: 202-564-1850
Email: atkinson.emily@epa.gov

From: Atkinson, Emily
Sent: Wednesday, May 18, 2016 10:22 AM
To: Drew Kodjak <drew@theicct.org>
Subject: RE: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation

Hi Drew,

It looks like we could fit this in as a 45 minute meeting on Tuesday, May 25 at 4:30pm ET. I have this spot on hold so let me know when you return on Friday what works best on your end.

Thank you.
Emily

Emily Atkinson
Staff Assistant
Immediate Office of the Acting Assistant Administrator
Office of Air and Radiation, USEPA
Room 5406B, 1200 Pennsylvania Avenue NW
Washington, DC 20460
Voice: 202-564-1850
Email: atkinson.emily@epa.gov

From: Drew Kodjak [mailto:drew@theicct.org]
Sent: Wednesday, May 18, 2016 3:18 AM
To: Atkinson, Emily <Atkinson.Emily@epa.gov>
Subject: Re: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation

Thanks Emily,

I'm in China at the moment, but I will follow up with you when I'm back in the States on Friday.

It would be useful to get a sense of Janet's availability before going back to my colleagues at major environmental organizations.

Talk soon

Drew

On May 18, 2016, at 3:52 AM, Atkinson, Emily <Atkinson.Emily@epa.gov> wrote:

Hi Drew,

Janet McCabe has reviewed this meeting request and would be happy for me to arrange a 45 minute meeting that would include Chris Grundler and OTAQ staff.

Let me know if you have a preferred date/time and I can work to fit this into Janet's schedule.

Emily

Emily Atkinson
Staff Assistant
Immediate Office of the Acting Assistant Administrator
Office of Air and Radiation, USEPA

Room 5406B, 1200 Pennsylvania Avenue NW
Washington, DC 20460
Voice: 202-564-1850
Email: atkinson.emily@epa.gov

From: Azoolin, Liel
Sent: Friday, May 13, 2016 3:10 PM
To: Drew Kodjak <drew@theicct.org>
Cc: Atkinson, Emily <Atkinson.Emily@epa.gov>
Subject: RE: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation

Hi Drew,

Thank you again for the request to meet with Administrator McCarthy on either May 24 or May 25.

We regret to inform you that unfortunately the Administrator's schedule will not be able to accommodate this meeting at this time.

However, we can offer a meeting with Janet McCabe, Assistant Administrator in the Office of Air and Radiation. I've looped in Emily Atkinson (cc'd above), so you may coordinate directly with her in scheduling this meeting.

Thank you,
Liel

From: Drew Kodjak [mailto:drew@theicct.org]
Sent: Tuesday, May 03, 2016 2:03 PM
To: Azoolin, Liel <Azoolin.Liel@epa.gov>
Cc: scheduling <scheduling@epa.gov>; McCabe, Janet <McCabe.Janet@epa.gov>; Grundler, Christopher <grundler.christopher@epa.gov>
Subject: Re: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation

Hi Azoolin,

Once we have the meeting scheduled, I expect to invite a couple additional representatives from major US environmental organizations: NRDC, EDF, Sierra Club, ACEEE.

Warm regards,

Drew

On May 3, 2016, at 9:59 AM, Azoolin, Liel
<Azoolin.Liel@epa.gov> wrote:

Hi Drew,

I apologize for the delayed response to your request. We are still working out the Administrator's schedule for the last week of May.

Would the meeting participants just be Ms. Oge and Mr. Kimmel or would anyone else like to join the meeting?

I will be in touch as soon as a determination of the Administrator's available has been made.

Please do not hesitate to reach out if you have any questions.

Thank you,
Liel

From: Drew Kodjak [mailto:drew@theicct.org]
Sent: Tuesday, May 03, 2016 8:10 AM
To: Azoolin, Liel <Azoolin.Liel@epa.gov>
Cc: McCabe, Janet <McCabe.Janet@epa.gov>; Grundler, Christopher <grundler.christopher@epa.gov>
Subject: Fwd: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation

Dear Ms. Azoolin, with copies to Assistant Administrator McCabe and Office Director Grundler,

I sent in a meeting request to visit with Administrator McCarthy ten days ago and have not yet received a response. I know these are busy times for the Agency, so I wanted to send this note again to move my request to the top of your inbox. Please see the note below.

With warm regards,

Drew Kodjak
Executive Director
International Council on Clean Transportation

Begin forwarded message:

From: "Drew Kodjak" <drew@theicct.org>
Subject: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation
Date: April 21, 2016 at 11:29:24 AM EDT
To: azoolin.liel@epa.gov
Cc: margo.oge@gmail.com, "Jonna Hamilton" <jhamilton@ucsusa.org>, "Alexandra Herrera" <alex.herrera@theicct.org>

Dear Ms. Azoolin,

My name is Drew Kodjak. I'm the executive director of the International Council on Clean Transportation. My organization works with governments in the world's top vehicle markets to support policies to reduce air pollution and climate change emissions from vehicles and fuels.

I'm writing today on behalf of Margo Oge, former office director of EPA's Office of Transportation and Air Quality, and Ken Kimmel, executive director of the Union of Concerned Scientists. We'd like to request a meeting with Administrator McCarthy to discuss the critically important mid-term evaluation of the 54.5 mpg regulations.

The United States is the global leader in this area. Its continued leadership is essential if the world is to achieve its global ambitions to reach our climate change goals proposed last year in Paris. The Obama Administration was instrumental in paving the way for last year's climate deal, and effective implementation of climate policies will demonstrate continued commitment.

One of the cornerstones of US climate policy is the light-duty vehicle fuel economy standards established from 2017 to 2025, commonly referred to as the 54.5 mpg regulations. These regulations are expected to double passenger vehicle fuel economy from 2010 to 2025, although this depends on the outcome of the mid-term evaluation. While some nations have more efficient fleets than the United States, no other nation has developed such appropriately ambitious policies.

We would like to share with the Administrator our perspectives on the importance of these standards, why we believe that these standards are cost effective even in light of today's low gasoline prices, and how these standards are necessary but not sufficient for driving transformational change in the automotive industry towards electric drive.

We have some available dates at the end of May: specifically May 24th in the morning; and May 25th in the afternoon after 2:30. Would you please let me know if either of these dates would work? If these dates do not work, would you please share with us some alternative dates and times that might work for the Administrator?

With warm regards,

Drew Kodjak
Executive Director

International Council on Clean Transportation
202-285-3672

To: Atkinson, Emily[Atkinson.Emily@epa.gov]
From: Drew Kodjak
Sent: Wed 5/18/2016 7:18:20 AM
Subject: Re: Request for Meeting with Administrator McCarthy on Light Duty Vehicle Mid-term Evaluation

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Emily Atkinson
Staff Assistant
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Office of Air and Radiation, USEPA
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Washington, DC 20460
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Email: atkinson.emily@epa.gov

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Sent: Tuesday, May 03, 2016 2:03 PM
To: Azoolin, Liel <Azoolin.Liel@epa.gov>
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To: Azoolin, Liel <Azoolin.Liel@epa.gov>
Cc: McCabe, Janet <McCabe.Janet@epa.gov>; Grundler, Christopher <grundler.christopher@epa.gov>
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Executive Director
International Council on Clean Transportation

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Cc: margo.oge@gmail.com, "Jonna Hamilton" <jhamilton@ucsusa.org>, "Alexandra Herrera" <alex.herrera@theicct.org>

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With warm regards,

Drew Kodjak
Executive Director
International Council on Clean Transportation
202-285-3672

Cc: Olechiw, Michael[olechiw.michael@epa.gov]; Drew Kodjak[drew@theicct.org]; Nic Lutsey[nic@theicct.org]; Anup Bandivadekar[anup@theicct.org]
To: Grundler, Christopher[grundler.christopher@epa.gov]; Charmley, William[charmley.william@epa.gov]
From: John German
Sent: Wed 8/3/2016 6:27:36 PM
Subject: Fwd: VIDEO: Sparks fly over 54.5

Chris et al,
You might want to talk to Automotive News about the 4 minute video clip they posted from yesterday's Management Briefing Seminars. They included Chris's assertion that more light-truck sales does not make it harder to meet CAFE/CO2 - but they cut him off before he explained why, leaving the impression that he expected manufacturers to do more to meet the standards than was anticipated for the 2017-25 rule.

John

Begin forwarded message:

From: "Automotive News" <autonews@CrainAlerts.com>
Subject: VIDEO: Sparks fly over 54.5
Date: August 3, 2016 at 11:31:14 AM EDT
To: <john@theicct.org>
Reply-To: "Crain Communications Inc." <reply-fec51c7476650c7f-10920_HTML-30195755-6330821-62@crainsubscription.com>

August 3, 2016

View in a Web browser | Forward to a colleague

Sparks fly over 54.5

Low gasoline prices, consumers who prefer light trucks, and pricey fuel-saving technologies aren't derailing the EPA's targeted 54.5 mpg fleet average by 2025. As a result, automakers, dealers and U.S. regulators continue to clash over how to craft future corporate average fuel economy standards.

CARS & CONCEPTS

To: Grundler, Christopher[grundler.christopher@epa.gov]
From: Corey, Richard@ARB
Sent: Sat 7/2/2016 2:49:27 AM
Subject: RE: Status of Draft TAR

Thanks Chris. I will follow-up on this indeed. We have a lot of work together and I have noted many times to Mary/others the tremendous leadership/progress you have brought to OTAQ and our relationship. I have been and continue be a big supporter of the direction you have taken the office and am not interested/supportive of getting it off track. If there is a legitimate issue lets discuss but my sense it is that is one of credit and if that is the issue it is time to move on. You have certainly called out the partnership/our role multiple times. Thus, I am not even sure what the expectation is. I will have the conversation on this to see if I can get to core issue which I frankly do not understand.

Have a great weekend/4th!

Richard

From: Grundler, Christopher [mailto:grundler.christopher@epa.gov]
Sent: Friday, July 01, 2016 7:17 PM
To: Corey, Richard@ARB
Subject: Re: Status of Draft TAR

Last word on this, I promise.

I do encourage you to probe this attitude, and find out if it will interfere with us working together in the future. As you know we have a lot we need to do together and this note reflects very poorly on Alberto. Snide remarks aimed at our administrator do not generate warm feelings of collegiality.

Christopher Grundler, Director

Office of Transportation and Air Quality

U.S. Environmental Protection Agency

202/564-1682 (Washington DC)

734/214-4207 (Ann Arbor MI)

On Jul 1, 2016, at 9:33 PM, Grundler, Christopher <grundler.christopher@epa.gov> wrote:

Yeah. It's not the first time. I ignore it and stay on the high road, but I find it bewildering. Gina mentioned Mary by name at the top of her remarks at the news conference. It is worse between AA and Drew Kodjak at ICCT. I think they are barely on speaking terms because ICCT has gotten a lot of attention on this story. Alberto declined our invitation to our international summit primarily because we also invited Drew. Fortunately the relationship with Annette and the rest of the team has really been strengthened throughout this ordeal

I would keep an eye on it.

Christopher Grundler, Director

Office of Transportation and Air Quality

U.S. Environmental Protection Agency

202/564-1682 (Washington DC)

734/214-4207 (Ann Arbor MI)

On Jul 1, 2016, at 4:36 PM, Corey, Richard@ARB <richard.corey@arb.ca.gov> wrote:

Not for Forwarding

What is eating at Alberto? I will follow up.

Sent from my iPhone

Begin forwarded message:

From: "Ayala, Alberto@ARB" <Alberto.Ayala@arb.ca.gov>
Date: July 1, 2016 at 12:16:56 PM PDT
To: "Grundler, Christopher" <grundler.christopher@epa.gov>, "Corey,

Richard@ARB" <richard.corey@arb.ca.gov>
Cc: "Charmley, William" <charmley.william@epa.gov>, "Hebert, Annette@ARB" <annette.hebert@arb.ca.gov>, "McCarthy, Mike@ARB" <michael.mccarthy@arb.ca.gov>, "Olechiw, Michael" <olechiw.michael@epa.gov>
Subject: RE: Status of Draft TAR

Yes. We can rest easy now that we know "EPA has our back" so thank you

---

Alberto Ayala, PhD, MSE

Deputy Executive Officer

CALIFORNIA AIR RESOURCES BOARD

1001 I Street, Sacramento, CA 95812

916.322.2892 (direct)

916.445.4383 (Exec. Office line)

Alberto.Ayala@arb.ca.gov

From: Grundler, Christopher [mailto:grundler.christopher@epa.gov]
Sent: Friday, July 01, 2016 10:42 AM
To: Corey, Richard@ARB
Cc: Charmley, William; Ayala, Alberto@ARB; Hebert, Annette@ARB; McCarthy, Mike@ARB; Olechiw, Michael
Subject: Re: Status of Draft TAR

Also, Janet and Mary have talked about the schedule and the new NOx text.

Have a great weekend everyone, and congratulations again on VW. I was able to congratulate Annette personally in DC yesterday, which was great.

C

Christopher Grundler, Director

Office of Transportation and Air Quality

U.S. Environmental Protection Agency

202/564-1682 (Washington DC)

734/214-4207 (Ann Arbor MI)

On Jul 1, 2016, at 12:27 PM, Corey, Richard@ARB <richard.corey@arb.ca.gov> wrote:

Bill:

Thanks for the update/status report on the schedule. This will pinch our scheduled Board update. But, I understand the situation.

Thanks again.

Richard

Sent from my iPhone

On Jul 1, 2016, at 7:34 AM, "Charmley, William" <charmley.william@epa.gov> wrote:

Dear Richard, Alberto Annette and Mike –

Yesterday we learned the following as a results of some discussions between the political appointees at EPA (Janet McCabe), DOT (Shoshana Lew) and Dan Utech.

Shoshana informed Dan and Janet that DOT will not be able to provide EPA and CARB with a revised version of the Draft TAR Chapter 13 (the unique NHTSA CAFE modeling and results chapter) until Tuesday, July 5th. Mike Olechiw passed this information on to Mike McCarthy yesterday, so Mike M. and his team would know there is no need to be keeping an eye on email over the 3-day holiday weekend.

If we don't even see the revised Chapter 13 until Tuesday of next week, then it is likely that EPA and CARB team could review and get comments back to DOT by the end of Tuesday or perhaps on Wednesday, and after DOT responds to our input, the soonest they could send the revised Chapter 13 to OMB is either late Wednesday or Thursday. OMB and other in the various White House agencies (CEQ, CEA ..) wouldn't get much time to review Chapter 13.

Because of this, the decision was made that we won't be able to release the Draft TAR next week, and **we have been given a goal to release the Draft TAR on Tuesday, July 12.**

I know this is disappointing, but at this point, that's where we are. Once we see the new Chapter 13 on Tuesday, my staff and I will propose a new, day-by-day schedule that we can all try to work towards.

Please let Chris or I know if you have any questions, or if any of you would like to discuss this over the phone.

Thanks

Bill

To: Grundler, Christopher[grundler.christopher@epa.gov]
From: Drew Kodjak
Sent: Thur 5/26/2016 10:12:10 AM
Subject: Re: Vicki

Well,

I guess she missed my statement at the beginning of the meeting that we would all have the courtesy of speaking our minds at the meeting with you and Bill, and then giving you the respect of informing you if we disagreed and would let you know if we felt the need to raise an issue with your bosses.

To me, this is bad faith and bad form. Not that EDF does not have the right to speak their mind and form their own opinions, but that they should respect all the trust and confidence that you are placing in the environmental community and repay it with a similar amount of respect.

I feel that Margo is also aligned with Chet and Vicki, but I'll give Margo credit for at least raising the issue of the mid-term evaluation at the meeting. I wonder what Margo would do with an environmental group that betrayed her trust in this way. . . .

I have a board meeting today, but I think this deserves a strong response, and I'm also happy to talk this through with you. To be clear, I'd like to help in the response as I am the one that brought everyone together at the meeting at the ICCT, and so I have a stake in making a strong response.

Drew

> On May 26, 2016, at 4:57 AM, Grundler, Christopher <grundler.christopher@epa.gov> wrote:
>
> ....was in lobbying Janet yesterday afternoon for a pull-ahead and a midterm review
>
> Christopher Grundler, Director
> Office of Transportation and Air Quality
> U.S. Environmental Protection Agency
> 202/564-1682 (Washington DC)
> 734/214-4207 (Ann Arbor MI)
>

To: Caldwell, Amy[caldwell.amy@epa.gov]; Wasenko, Barbara[Wasenko.Barbara@epa.gov]; Hengst, Benjamin[Hengst.Benjamin@epa.gov]; Betty Stendel[stendel.betty@epa.gov]; Kolowich, Bruce[kolowich.bruce@epa.gov]; Grundler, Christopher[grundler.christopher@epa.gov]; Mylan, Christopher[Mylan.Christopher@epa.gov]; Haugen, David[haugen.david@epa.gov]; Debra L. Miller[Miller.debral@epa.gov]; Watkins, Erica[Watkins.Erica@epa.gov]; Birgfeld, Erin[Birgfeld.Erin@epa.gov]; Galano, Fidel[Galano.Fidel@epa.gov]; Johnson, Francene[Johnson.Francene@epa.gov]; Stewart, Gwen[Stewart.Gwen@epa.gov]; Jones, Jacqueline[Jones.Jacqueline@epa.gov]; Blubaugh, Jim[Blubaugh.Jim@epa.gov]; Weihrauch, John[Weihrauch.John@epa.gov]; Iffland, JoNell[Iffland.JoNell@epa.gov]; Berrier, Judi[Berrier.Judi@epa.gov]; Greuel, Justin[Greuel.Justin@epa.gov]; Simon, Karl[Simon.Karl@epa.gov]; Sargeant, Kathryn[sargeant.kathryn@epa.gov]; Vawters, Katie[Vawters.Katie@epa.gov]; Derksen, Kimberly[derksen.kimberly@epa.gov]; Cook, Leila[cook.leila@epa.gov]; McQueen, Lyndia[mcqueen.lyndia@epa.gov]; Le, Madison[Le.Madison@epa.gov]; Peralta, Maria[Peralta.Maria@epa.gov]; Brusstar, Matt[brusstar.matt@epa.gov]; Michael Horowitz[horowitz.michael@epa.gov]; Sabourin, Michael[sabourin.michael@epa.gov]; Haley, Mike[Haley.Mike@epa.gov]; Cooper, Nanette[cooper.nanette@epa.gov]; Paff, Patricia[paff.patricia@epa.gov]; Shaffer, Patricia[Shaffer.Patricia@epa.gov]; Argyropoulos, Paul[Argyropoulos.Paul@epa.gov]; Curtis, Rhonda[Curtis.Rhonda@epa.gov]; Larson, Robert[larson.robert@epa.gov]; Waite, Sherry[waite.sherry@epa.gov]; Patterson, Susan[Patterson.Susan@epa.gov]; Nelson, Suzanne[nelson.suzanne@epa.gov]; Meekins, Tanya[Meekins.Tanya@epa.gov]; Moore, Theresa[Moore.Theresa@epa.gov]; Bradish, Tracey[bradish.tracey@epa.gov]
Cc: Gonzalez, Gail[Gonzalez.Gail@epa.gov]; Zaremski, Sara[zaremski.sara@epa.gov]; Wilson, Donna[Wilson.Donna@epa.gov]; Soth, Judith[Soth.Judith@epa.gov]; Davis, Theresa[Davis.Theresa@epa.gov]
From: Stewart, Gwen
Sent: Wed 5/25/2016 11:52:17 AM
Subject: CHRISTOPHER GRUNDLER CALENDAR

CHRISTOPHER GRUNDLER

WEDNESDAY, MAY 25, 2016

CALENDAR

DC OFFICE

8:30 AM – 10:00 AM General Discussion with DOE/Reuben Sarkar

Location: RM. 6520 DC

10:00 AM – 12:30 PM Meeting with ICCT

Location: ICCT Offices

12:30 PM – 1:00 PM Management Time

1:00 PM – 1:30 PM OIG's Annual Outreach Meeting with OAR

Location: RM. 5400 DC

1:30 PM – 2:00 PM HD GHG Phase 2 -Weekly Meetings

Location: RM. 6520 DC/RM. C-174 DOD AA

Ex. 6 - Personal Privacy

2:00 PM – 3:00 PM HOLD: ACTIVE SHOOTER

Location: RM. 1153 EAST

Informational.

2:30 PM – 4:00 PM Autonomous Vehicle Webinar

Location: VIA LINK

4:30 PM – 5:15 PM Light Duty Midterm Evaluation with Administrator and NGOs

Location: ALM Conference Room

Gwen Stewart

Office of Transportation and Air Quality

202 564-1682 – Telephone

202 564-1686 – Fax Number

Stewart.gwen@epa.gov

To: Charmley, William[charmley.william@epa.gov]
Cc: Ayala, Alberto@ARB[Alberto.Ayala@arb.ca.gov]; Grundler, Christopher[grundler.christopher@epa.gov]
From: Corey, Richard@ARB
Sent: Mon 5/23/2016 10:47:20 AM
Subject: Re: Today's EPA/DOT/CARB meeting with the environmental and consumer NGOs on the light-duty Mid-term Evaluation

Bill:

Thanks for the background regarding the meeting/call. I am out of town on vacation and will unfortunately miss it but know you all have it handled. I would also expect some hard questions that will probe at that issues with DOT which several from the NGO community are aware. I am interested in how DOT chooses to respond to some of the questions which will almost certainly come up.

Richard

Sent from my iPhone

On May 23, 2016, at 6:18 AM, "Charmley, William" <charmley.william@epa.gov> wrote:

Dear Richard and Alberto,

Today there is an EPA/CARB/DOT meeting scheduled with a wide range of members from the environmental and consumer NGO community on the light-duty MTE process.

I sent a version of this note to Chris Grundler and Janet for background, and I thought it would be helpful for both of you. My understanding is this meeting is on both of your calendars.

This meeting has been in the works for several months, it has nothing to do with the current back-and-forth with NHTSA on the details of the underlying assessment for the Draft TAR. Robin Moran and I realized this past January that EPA/CARB/NHTSA had not done had the coordinated engagement with the environmental NGOs to the same extent we had with the autos and the suppliers. For the autos/suppliers, EPA/CARB/NHTSA have had many joint meetings – including several with Chris Grundler and Alberto Ayala. We encouraged the NGOs to request a meeting with the 3 agencies to provide their overall views on the MTE process before the Draft TAR is released. That's what this meeting was designed to be.

The list of stakeholders is very broad coalition of environmental and consumer NGOs that are very interested in the light-duty GHG/CAFE program. Either in person or via phone we expect the following groups to participate:

- Union of Concerned Scientists
- Environment America
- Natural Resources Defense Council
- Consumers Union
- Cater Communications
- Environmental Defense Fund
- Sierra Club
- American Council on an Energy Efficient Economy
- International Council on Clean Transportation
- Safe Climate Campaign
- Consumer Federation of America
- Blue Green Alliance
- Ceres
- Better World Group
- Pew Charitable Trusts

In the attached you will see some of the key messages we have heard from UCS that the NGOs intend to highlight today for the 3 Agencies – which I will also highlight below.

Note that the issue of the 54.5 MPG target will probably come up. Most of the participants for the NGO meeting are well-versed in the details of the footprint-curve basis of the standards. They understand that if more trucks are bought than cars than the fleet-wide standard in 2025 will be lower than 54.5 MPG. Our understanding is the environmental community has a wide range of views on this – they are not all of one mind. Some believe this is a sencondary story (the standards are the curves, not 54.5), others are disappointed and would like the agencies to consider increasing the stringency or at least quickly initiating a rule for 2026 and later to get back to and exceed 54.5 mpg; and others (Dan Becker from Safe Climate Campaign, who will be on the phone) have said publically that this is a broken promise from the President and the agencies much increased the stringency in the MTE to strengthen the standards and deliver the promised 54.5.

The NGOs for at least the past 8 months have been suggesting that the 3 agencies should take another step on the MTE process by the end of this year – so we expect to hear that as well, a call for the agencies to issue a Final TAR or other action by the end of 2016.

Overall I think that our approach to this meeting should be to listen and thank the NGOs for their engagement. They have initiated a range of projects to bring new information to the table for the MTE process, and I believe we will hear about some of those as well.

Thanks

Bill

<< expected messages from Environmental and Consumer NGOs on the Light-duty MTE process >>

• Maintain benefits of the President's program expected when the standards were finalized

▪ Concerned about shortfalls in CO_2 benefits – and need for even further reductions post-Paris

▪ Note: Several NGOs have communicated confidentially to us that they will push for strengthening the standards – as a counterpoint to the autos' push for weakening -- but in the end will view maintaining stringency as success

• MTE analysis must be based on a single government analysis, using the most up-to-date data

▪ Will point to rapid auto industry technology advancements and seek assurance that agencies are using all the latest data, projected to 2025

▪ By "single government analysis" – the NGOs don't mean have only one assessment, but that the 3 agencies should speak with one voice

• NGOs have a number of research projects underway which they'll share as comments on the draft TAR, or later in MTE process:

▪ E.g., consumer attitudes toward fuel economy (CFA), jobs (NRDC/BGA), auto profits (Ceres), technology briefing series (ICCT), pickup truck study (ACEEE)

• Need for a strong finish – Draft TAR timing critical; importance of Final TAR

• Need to start thinking about post-2025

<Backgrounder_NGO Meeting on MTE.DOCX>

To: 'richard.corey@arb.ca.gov'[richard.corey@arb.ca.gov]; Ayala, Alberto@ARB[Alberto.Ayala@arb.ca.gov]
Cc: Grundler, Christopher[grundler.christopher@epa.gov]
From: Charmley, William
Sent: Mon 5/23/2016 10:18:17 AM
Subject: Today's EPA/DOT/CARB meeting with the environmental and consumer NGOs on the light-duty Mid-term Evaluation
Backgrounder_NGO Meeting on MTE.DOCX

Dear Richard and Alberto,

Today there is an EPA/CARB/DOT meeting scheduled with a wide range of members from the environmental and consumer NGO community on the light-duty MTE process.

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- Need for a strong finish – Draft TAR timing critical; importance of Final TAR

- Need to start thinking about post-2025

To: Grundler, Christopher[grundler.christopher@epa.gov]
From: Drew Kodjak
Sent: Fri 5/6/2016 12:50:19 PM
Subject: Note to Janet

Chris,
Good suggestions to copy Janet on my request for a Gina meeting. My call with her got cancelled this morning, so I shot her a couple notes below. She's a class act.

Ex. 6 - Personal Privacy

Drew

Begin forwarded message:

From: Drew Kodjak <drew@theicct.org>
Subject: Re: Schedule change
Date: May 6, 2016 at 8:37:35 AM EDT
To: "McCabe, Janet" <McCabe.Janet@epa.gov>
Cc: "Atkinson, Emily" <Atkinson.Emily@epa.gov>

Thanks for letting me know Janet.
I would like to reschedule, but in the mean time, this is what I had prepared to mention to you today in brief. There are a couple other important items that I wanted to discuss that are not covered below, but here is the bulk of the information.

1. The TAR

- Just to confirm what I think is well recognized by you and your team: It's important to be able to publish the TAR this June / July in order to allow sufficient time for public notice and comment, response to comment from the agencies, and a "final" TAR by end of the year. This was establish a formal evidentiary basis for a strong proposal next year.
- My second point on the TAR is that to lay ground work for a post-2025 standards, it would be useful for the TAR to seek comment on technology potential beyond 2025. This would enable a formal comment from the ICCT and others. We are doing work in Europe to assess costs and effectiveness of efficiency technologies for the European market in 2025 and 2030 through our consultant FEV, a major global auto consultant that EPA also uses. The results are showing that costs are coming down. We will publish results in the next several months, which we could feed into our comments on the TAR.

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- We are working with major suppliers to develop a series of 10 page "technology briefing" papers that examine the progress to date on the key technologies identified in the 2025 GHG standards, such as turbo/downsize, naturally aspirated, hybrids, light weighting, etc. The first paper on naturally aspirated engines (a fancy term for the typical engines currently used in passenger vehicles) is going to show that this lower cost technology pathway has improved substantially since the rule was published, and can now be expected to be a compliance pathway in 2025 for the smaller, 4-cylinder engine vehicles. Evidence includes reference to Mazda's Skyactiv, Toyota's Atkinson cycle engines, and GM's skipfire / cylinder deactivation technology. The first paper will be published next month, with others following.

3. Compliance

- Germany, UK, and France all published the results of their compliance testing two weeks ago. My team has analyzed the data and published a number of blogs. Our blog on the German data shows that all passenger diesels tested were emitting far in excess of the type approval limits. Moreover, VW's were in the middle of the pack with a number of brands far worse including Fiat, Nissan, Land Rover, Jeep, Chevy, Renault, Suzuki. http://www.theicct.org/blogs/staff/first-look-results-german-transport-ministrys-post-vw-vehicle-testing.
- A second blog examined the test methods used by the three nations, finding that these screening tests were not sufficient - after 6 months - to demonstrate illegal activity, but only that those manufacturers that might should be examined further. This is because there needs to be additional testing - after discussions with the manufacturers to gather their reasons for the excess emissions - to either prove or disprove the OEM's claims. The UK appears to have taken the manufacturer rationale's for excess emissions at face value, even some claims that are without engineering credibility. It remains to be seen whether the European countries will continue to conduct testing to either prove or disprove manufacturer claims. http://www.theicct.org/blogs/staff/defeat-device-testing-eu-so-far-not-so-good. But, for context, we should not forget that it took over a year for EPA / CARB to finally determine that defeat devices were used by VW in the US, and only after a confession was extracted through EPA engagement.
- Final note: These initial results in Europe demonstrate to me the importance of EPA's international activities to support credible testing, data transparency, etc. I thought the International Compliance Summit was an important step in bringing nations together. The next Summit will hopefully take place in the fall of this year in Italy.

Warm regards,

Drew

On May 5, 2016, at 9:19 PM, McCabe, Janet <McCabe.Janet@epa.gov> wrote:

Drew--I've had a schedule change at theist minute for tomorrow morning, so I'm going to have reschedule our call. Perhaps you've already heard this from my office.

Anyway, my apologies, and we'll get it rescheduled as soon as we can.

Sent from my iPhone

Background: NGO Meeting on MTE with EPA/NHTSA/CARB
(EPA Internal, Deliberative Material)
May 23, 2016 @ 1pm

In person attendees:
- Jonna Hamilton, Union of Concerned Scientists
- Aminah Zaghab, Environment America
- Luke Tonachel, Natural Resources Defense Council
- Jason Kuruvilla, Consumers Union
- Aaron Huertas, Cater Communications
- Chet France, Environmental Defense Fund
- Andrew Linhardt, Sierra Club
- Siddiq Khan, American Council on an Energy Efficient Economy
- Drew Kodjak, International Council on Clean Transportation *
- John German, International Council on Clean Transportation *
- Michelle Robinson, Union of Concerned Scientists *

Phone Attendees:
- Dan Becker, Safe Climate Campaign
- Jack Gillis, Consumer Federation of America
- Mel Hall-Crawford, Consumer Federation of America
- Zoe Lipman, Blue Green Alliance
- Carol Lee Rawn, Ceres
- Ruben Aronin, Better World Group
- Hilary Sinnamon, Environmental Defense Fund
- Jason Wynne, Pew Charitable Trusts
- Nic Lutsey, International Council on Clean Transportation *

*Tentative

NGO's Top-Line Messages

Ex. 5 - Deliberative Process

To: Drew Kodjak[drew@theicct.org]
From: Grundler, Christopher
Sent: Thur 5/26/2016 11:29:47 AM
Subject: Re: Vicki

I will certainly think twice before including them in future meetings.

Christopher Grundler, Director
Office of Transportation and Air Quality
U.S. Environmental Protection Agency
202/564-1682 (Washington DC)
734/214-4207 (Ann Arbor MI)

> On May 26, 2016, at 6:12 AM, Drew Kodjak <drew@theicct.org> wrote:
>
> Well,
>
> I guess she missed my statement at the beginning of the meeting that we would all have the courtesy of speaking our minds at the meeting with you and Bill, and then giving you the respect of informing you if we disagreed and would let you know if we felt the need to raise an issue with your bosses.
>
> To me, this is bad faith and bad form. Not that EDF does not have the right to speak their mind and form their own opinions, but that they should respect all the trust and confidence that you are placing in the environmental community and repay it with a similar amount of respect.
>
> I feel that Margo is also aligned with Chet and Vicki, but I'll give Margo credit for at least raising the issue of the mid-term evaluation at the meeting. I wonder what Margo would do with an environmental group that betrayed her trust in this way. . . .
>
> I have a board meeting today, but I think this deserves a strong response, and I'm also happy to talk this through with you. To be clear, I'd like to help in the response as I am the one that brought everyone together at the meeting at the ICCT, and so I have a stake in making a strong response.
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>> Christopher Grundler, Director
>> Office of Transportation and Air Quality
>> U.S. Environmental Protection Agency
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>> 734/214-4207 (Ann Arbor MI)
>

To: Drew Kodjak[drew@theicct.org]
From: Grundler, Christopher
Sent: Thur 5/26/2016 11:24:10 AM
Subject: Re: Vicki

She did arrive late and missed your remarks. I do think it's bad manners tho. I continue to be bewildered by her behavior. In any case both issues are lost causes

Christopher Grundler, Director
Office of Transportation and Air Quality
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To: Drew Kodjak[drew@theicct.org]
From: Grundler, Christopher
Sent: Fri 5/6/2016 12:51:51 PM
Subject: Re: Note to Janet

Excellent!!

In line at WH which is why your call got cancelled.

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Office of Transportation and Air Quality
U.S. Environmental Protection Agency
202/564-1682 (Washington DC)
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engineering credibility. It remains to be seen whether the European countries will continue to conduct testing to either prove or disprove manufacturer claims. http://www.theicct.org/blogs/staff/defeat-device-testing-eu-so-far-not-so-good. But, for context, we should not forget that it took over a year for EPA / CARB to finally determine that defeat devices were used by VW in the US, and only after a confession was extracted through EPA engagement.

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Sent from my iPhone

To: danair@ucsusa.org[danair@ucsusa.org]
From: Don Anair
Sent: Tue 1/27/2015 6:59:14 PM
Subject: New UCS blog: Why low gas prices are no reason to roll back fuel economy and emission standards
removed.txt
image002.jpg
image003.jpg
image004.png

Hi,
I wanted to share a recent blog post that might be of interest. I address some of the recent media coverage and automaker statements, particularly Chrysler, encouraging a change in fuel economy standards.
Thanks,
-Don

http://blog.ucsusa.org/dear-chrysler-5-reasons-oil-prices-shouldnt-affect-fuel-economy-standards-800

Dear Chrysler: 5 Reasons Oil Prices Shouldn't Affect Fuel Economy Standards<http://blog.ucsusa.org/dear-chrysler-5-reasons-oil-prices-shouldnt-affect-fuel-economy-standards-800>
[Description: Description: Don Anair]
Don Anair<http://blog.ucsusa.org/author/don-anair>, research and deputy director, Clean Vehicles<http://blog.ucsusa.org/author/don-anair>

January 27, 2015

Lately, low gas prices have been making headlines across the country. Having dropped by more than $1.50/gallon over the last 6 months, there is certainly reason to be talking about them. So it was no surprise when the topic came up at the North American International Auto Show earlier this month in Detroit. The CEO of Chrysler, Sergio Marchionne, used the opportunity to call for rolling back vehicle fuel economy standards<http://www.freep.com/story/money/cars/detroit-auto-show/2015/01/14/marchionne-fca-fiat-chrysler-fuel-cafe/21739597/>. This is perhaps not surprising from a CEO who also tells people not to buy his company's electric cars<http://www.autonews.com/article/20140524/COPY01/305249994/marchionne-urges-u.s.-customers-not-to-buy-the-fiat-500e-ev> and who's company has scored last in 6 out of 7 UCS Automaker Rankings<http://blog.ucsusa.org/why-chrysler-has-the-dirtiest-tailpipe-and-why-i-want-to-see-them-do-better-628>. But his statements on fuel economy appear to be as volatile as oil prices. Just a couple of years ago<http://www.mlive.com/auto/index.ssf/2011/08/marchionne_chrysler_can_use_pl.html> he stood up with the President and supported the new standards.

Low gas prices do not mean it's time to roll back clean vehicle standards - and here are 5 good reasons why:

1. We need cleaner cars AND trucks. Much has been made of recent vehicle sales showing a market shift toward larger vehicles, with last week's WSJ article "Clash Looms Over Fuel Economy Standard<http://www.wsj.com/articles/auto-makers-regulators-on-fuel-economy-collision-course-1421174452>" highlighting the pushback expected from automakers on fuel economy standards. Regardless of what's causing the shift (and I dare say it is more than just low gas prices - since the increasing market share for trucks started in 2013<http://www.epa.gov/otaq/fetrends.htm> and was projected to grow in 2014 well before anyone knew gas prices were going to plummet), it's important to understand what impact that will have on automakers ability to comply with federal fuel economy and greenhouse standards.
[Description: Description: http://blogs.cars.com/.a/6a00d83451b3c669e2017eea558dc0970d-pi]

A vehicle manufacturer's fuel economy requirements are based on the size of vehicles sold, as defined by the vehicle footprint (track width multiplied by the wheelbase). A larger wheel base means a lower fuel economy target.

In a word - none.

Increased market share of larger vehicles will lead to more oil consumption and emissions, but it's no reason to rollback standards. In fact, the standards were designed to accommodate shifts in the vehicle mix. Instead of setting a single fuel economy or greenhouse gas emission number and making every manufacturer meet it, the standards are set based on the size (or footprint) of the vehicles that are sold by each manufacturer.

The fuel economy and greenhouse gas standards are often described as requiring automakers to meet a 54.5 mpg standard in 2025. In reality, this figure is just an estimate based on an assumption about the size of vehicles that are expected to be sold in 2025 across the entire US market. If the size of vehicles sold in 2025 differs from the assumptions, then so will the average fuel economy target for each manufacturer.
[Description: Description: 2015-ford-f-150-09]<http://blog.ucsusa.org/wp-content/uploads/2015-ford-f-150-09.jpg>

Can automakers meet fuel economy standards if they sell more trucks? Absolutely. If Ford stopped selling cars, and only sold F150's with it's new 2.7 liter V6 EcoBoost engine, Ford would not only be compliance with today's standards, but would already be complying with standards as far out as 2021. (Photo: Courtesy of Ford Motor Company.)

Consider this. What if Ford only sold F150's equipped with their new 2.7-liter EcoBoost engine and no other vehicles?

You might think they wouldn't have a chance at meeting the fuel economy standards. In fact, not only would they be in compliance with this year's fuel economy target, but Ford would be years ahead of the standard.

The two-wheel drive 2015 F150 2.7L is rated on government fuel economy tests at a combined highway/city fuel economy of 28.5 mpg (the actual consumer label value is 22 mpg - see more about the difference in this factsheet<http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_vehicles/Translating-Standards-into-On-Road.pdf>). The average footprint of the F150 is 65.67 sq ft assuming the shortest truck bed length option and the current market share of standard, crew and extended cab versions of the F150. The fuel economy target in 2015 for a truck with this size footprint is 24.83 mpg and doesn't reach 28 mpg until 2021. Even the four-wheel drive version of the F150 with slightly worse fuel economy already meets the standard set for 2019.

So a shifting market share to trucks is not an excuse for a change in the standards, but certainly highlights the importance of implementing other policies to reduce fuel use and greenhouse gas emissions from transportation. Complementary policies include putting a price on carbon, consumer rebates to reduce the cost of cleaner cars or fees on higher emission vehicles, and low carbon fuel standards, among others.

2. Learn from history or be doomed to repeat it. Remember the sky-rocketing gas prices and subsequent economic crash of 2008? Fuel economy standards stalled in the 90's and early 2000's in large part due to automaker's intransigence. As gas prices rose, U.S. automakers were particularly vulnerable given their inefficient product offerings and better positioning by their global rivals with more efficient vehicle choices. This ultimately led to bankruptcy for GM and Chrysler. Consumers were complicit as well, shifting their purchases to larger, inefficient SUVs and trucks when gas prices were low.

Making policy and purchasing decisions based on the assumption that current gas prices will stay low has been tried before with devastating effect. Calling for a change in in standards because of plunging oil prices is a classic example of short-term thinking that totally ignores that prices will rise and fall again, probably many times before 2025.[Description: Description: gas prices]<http://blog.ucsusa.org/wp-content/uploads/gas-prices.png>

3. What goes down must go up. Gas prices are volatile and dependent on global supply and demand. The current oil market is being influenced by both (according to EIA analysis<http://www.eia.gov/analysis/studies/gasoline/>). Fuel economy standards are partly responsible as improving efficiency of U.S. vehicles has slowed demand<http://www.ucsusa.org/press/2014/fuel-economy-trends-report-shows-americans-are-saving-billions-pump-science-group-finds> for oil in the U.S. while a boom in U.S. oil production has led to increasing global supply.

However, oil companies are already responding to lower oil prices. Stories of oil field layoffs<http://www.nytimes.com/2015/01/20/business/energy-environment/in-texas-hunkering-down-for-the-oil-bust.html> and reductions in oil company investments<http://www.nytimes.com/2014/12/09/business/energy-environment/oil-falls-to-5-year-low-and-companies-start-to-retrench-.html> in oil exploration and development should be a warning sign. At oil prices below $50 a barrel, fracking for hard-to-get oil in the U.S. is likely an economically losing proposition<http://www.wsj.com/articles/energy-boom-can-withstand-steeper-oil-price-drop-1414627471>. As investments wane in production, so will supply to the oil markets. There's plenty of debate about how and when oil prices might change, but if history is any lesson volatile oil prices are here to stay.

Fuel economy standards remain an effective insurance policy against volatile oil prices. By 2025 new car fuel consumption will be about half compared to model year 2010. No matter if fuel prices are $3.00 or $6.00, keeping the standards in place means a vehicle owner's fuel bill will be cut in half for the life of the vehicle, not just when oil prices happen to be low.

4. Fuel economy remains a top consideration for consumers. Fuel economy is by no means the only consideration when buying a vehicle. Passenger seating, cargo capacity, and others are key factors in car buying decisions. But most people want their vehicle to also use the least amount of fuel possible, as well as do everything else that's important to them. This is true despite low gas prices, as seen by the results of the recent J.D. Power's study<http://autos.jdpower.com/content/study-auto/uzc2IUv/2015-u-s-avoider-study-results.htm> which found fuel economy remains the most influential factor for new vehicle buyers for the fourth year in a row.

5. Electric cars are key to cutting oil use and climate emissions - now's no time to slow down. Low gas prices are not helpful to boosting electric vehicle sales, but it doesn't mean the sky is falling either. A quick look at the Department of Energy's eGallon calculator <http://energy.gov/maps/egallon> shows the average fuel costs for an EV are about half that of a comparable conventional gasoline vehicle. In many states, charging on off-peak hours (when your car is parked overnight) means even lower fuel costs. Last year plug-in EV sales, both plug-in hybrid and battery-electric, grew by 23 percent<http://www.hybridcars.com/december-2014-dashboard/>.

California's Zero Emission Vehicle (ZEV) program, also being implemented in 9 other states, is helping to propel the EV market forward and compelling automakers to invest in these technologies. This is important to make sure EVs, a key strategy to cutting our projected oil use in half by 2035 and slashing our carbon emissions 80% by 2050, become more cost competitive and a viable option for more consumers. Many of the states, including CA, that have adopted the ZEV program are also committing resources to making the roll out of these vehicles a success with state incentives, carpool lane access, infrastructure development, and other support. In other words, the automakers are not alone in this endeavor.

In terms of meeting the federal fuel economy and greenhouse gas standards for 2025, the vast majority of compliance will come from "plain vanilla technology" as Chrysler CEO Marchionne put it - meaning improvements in engines, transmission, and other conventional technologies. EPA's estimates for compliance with the standards show only about 5% hybrids and 2% plug-in vehicles needed in 2025 to achieve a fleet average the equivalent of 54.5 mpg. Every EV a manufacturer sells in a ZEV state will help them meet the federal fuel economy and greenhouse gas standards, but there's no requirement for automakers to be selling millions of EVs outside of ZEV states to comply with fuel economy standards now or in 2025. Of course that doesn't mean there isn't a market for them, like in Atlanta for example.

When supporting the standards in 2011:
<http://www.mlive.com/auto/index.ssf/2011/08/marchionne_chrysler_can_use_pl.html>

Marchionne said the three Detroit automakers ended a "bad habit of crying wolf" and opposing higher standards. That's largely because the companies' current chief executives came from outside the industry.

...

"We looked at this and said this can be done, as business people who did not grow up and did not become conditioned by traditions of Detroit," Marchionne said.

Perhaps Mr. Marchionne has spent a little too much time in Detroit.

Don Anair
Research and Deputy Director, Clean Vehicles Program
Union of Concerned Scientists
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phone: 510-809-1563
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danair@ucsusa.org<mailto:danair@ucsusa.org>

To: Dave Cooke[DCooke@ucsusa.org]
Cc: Alson, Jeff[alson.jeff@epa.gov]; Burke, Susan[Burke.Susan@epa.gov]; Snapp, Lisa[snapp.lisa@epa.gov]
From: Hula, Aaron
Sent: Mon 11/16/2015 3:15:03 PM
Subject: RE: New UCS Report on Lifetime Emissions of EVs

Thanks Dave, I will certainly take a look at the report.

Just out of curiosity, can you share the calculations behind the calculator? I've also put together a calculator based on eGrid and Greet and I'd be curious to see if our methodologies line up.

You may know about this, but a simple version is on fueleconomy.gov (it's a bit buried, and the web version needs to be updated to newer eGRID and GREET numbers):

http://www.fueleconomy.gov/feg/Find.do?action=bt2

Aaron

From: Dave Cooke [mailto:DCooke@ucsusa.org]
Sent: Thursday, November 12, 2015 12:05 PM
To: Charmley, William
Cc: Alson, Jeff; Hula, Aaron
Subject: New UCS Report on Lifetime Emissions of EVs

Bill, et al.,

Today, the Union of Concerned Scientists released a new report, Cleaner Cars from Cradle to Grave: How Electric Cars Beat Gasoline Cars on Lifetime Global Warming Emissions (summary attached). We found that over their entire lifetimes—from manufacturing to disposal—battery electric cars produce *half* the global warming emissions, on average, of comparably-sized gasoline cars. In addition, driving powered by electricity is cleaner than via gasoline on global warming emissions everywhere in the country, and has been improving over the last three years.

While I know this doesn't directly impact the mid-term review, it does more clearly show the impact that electric vehicles can have on the environment as we look to 2025 and beyond. We also released a new web tool that calculates the emissions from various EV models in zip codes across the United States to help inform folks about how EVs would compare in their own locale.

Please feel free to share the report and tool with anyone in your network you feel appropriate. If you have any questions, I'm happy to speak to them as best I can or could put you in touch with the report's author. Thanks,

- Dave

David W. Cooke, Ph.D.

Vehicles Analyst

Union of Concerned Scientists

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e: dcooke@ucsusa.org

To: Moran, Robin[moran.robin@epa.gov]
From: John German
Sent: Mon 12/19/2016 8:42:50 PM
Subject: Fwd: Technology papers - Publication of Transmission Working Paper

Sorry, Robin. Forgot to include you on copy list.
John

Begin forwarded message:

From: John German <john@theicct.org>
Subject: Re: Technology papers - Publication of Transmission Working Paper
Date: December 19, 2016 at 3:37:34 PM EST
To: Bill Charmley <charmley.william@epa.gov>, Michael Olechiw <olechiw.michael@epa.gov>, "Alson, Jeff" <alson.jeff@epa.gov>, "Alberto@ARB Ayala" <Alberto.Ayala@arb.ca.gov>, Mike McCarthy <michael.mccarthy@arb.ca.gov>
Cc: Anup Bandivadekar <anup@theicct.org>, NIc Lutsey <nic@theicct.org>, Joe Schultz <joe@theicct.org>, Aaron Isenstadt <aaron.isenstadt@theicct.org>

FYI, we just published our detailed working paper on lightweighting, written in cooperation with suppliers:
http://www.theicct.org/lightweighting-technology-development-and-trends-us-passenger-vehicles

Except for the diesel working paper, which we hope to publish in February, this is the last of our working papers. You can find the home page for all of the pages at:
http://www.theicct.org/series/us-passenger-vehicle-technology-trends
Note that the page includes both the detailed working papers we wrote with suppliers and the shorter ICCT technology briefs, so most of the subjects are listed twice.

Specific web links for the other detailed technology working papers are as follows:
http://www.theicct.org/downsized-boosted-gasoline-engines
http://www.theicct.org/automotive-thermal-management-technology
http://www.theicct.org/PV-technology-transmissions-201608
http://www.theicct.org/naturally-aspirated-gas-engines-201606
http://www.theicct.org/hybrid-vehicles-trends-technology-development-and-cost-reduction

Please let me know if you have any questions or would like additional information.

John

On Aug 29, 2016, at 2:29 PM, John German <john@theicct.org> wrote:

FYI, we just published our second detailed technology working paper, this one on

transmissions. Dana, BorgWarner, ITB, and FEV contributed to this paper:
http://www.theicct.org/PV-technology-transmissions-201608

Unfortunately, we have not yet finished ICCT's technology "brief" on transmissions, summarizing the results and adding a bit about implications on the mid-term review. I will let you know when this has been completed.

The papers on gasoline turbocharged engines and thermal management have finished supplier review and are now undergoing a final internal review by our communications team. The lightweighting paper was sent out for supplier review on Aug. 10, with their comments due by August 31. We are still hopeful that these can be finished by the end of September, with the paper on diesels following by the end of the year.

John

On Jun 21, 2016, at 10:51 AM, John German <john@theicct.org> wrote:

FYI, we just published two papers on naturally aspirated gasoline engines. These are the first in a series of technology reports in support of the 2017-25 mid-term review. Reports on transmissions, gasoline turbocharged engines, lightweighting, and thermal management will (hopefully) be finished by September, with a report on diesels following by the end of the year.

The first paper is the detailed working paper that we did in collaboration with Eaton, BorgWarner, and ITB.
Working paper: <http://theicct.org/naturally-aspirated-gas-engines-201606>

The second is ICCT's technology "brief", which summarizes the results of the working paper and adds a bit about implications on the mid-term review.
Tech brief: <http://theicct.org/naturally-aspirated-engines-techbrief-jun2016>

Let me know if you have any questions or want additional information.

John

Cc: Drew Kodjak[drew@theicct.org]; Nlc Lutsey[nic@theicct.org]; Olechiw, Michael[olechiw.michael@epa.gov]; Moran, Robin[moran.robin@epa.gov]
To: Charmley, William[charmley.william@epa.gov]
From: John German
Sent: Tue 7/5/2016 2:56:09 AM
Subject: Re: ICCT working paper on naturally aspirated gasoline engines and deac.

Thanks for the kind words, Bill.
Status of the working papers is as follows:

- Naturally aspirated gasoline - Done
- Transmissions - In final draft, including supplier reviews. Just needs a final OK from suppliers and an internal editorial review.
- Turbocharged gasoline - Complete first draft sent to suppliers last week for review (and possibly additional and information). Review deadlines: additional data by July 22, comments by Aug. 12. We will likely have a much larger group of suppliers at least review the draft than participated in the NA gasoline and transmissions papers.
- Thermal management - ITB has sent us two drafts and ICCT has added our technical comments (and reorganized the draft). BorgWarner is currently reviewing - their review is supposed to be done by the end of next week. Then, submission to all potential participants for a final review, followed by ICCT editorial review.
- Lightweighting - Aaron is working on the first complete draft. However, we are still waiting for a couple promised writeups from suppliers. Hopefully, we can finish a complete first draft by Aug. 7 and send it out for review.
- Diesels - This has been postponed, as we don't have staff to work on it. We will start work on this when the other technology papers are well in hand - likely sometime in September.

Publication of the papers, beyond the naturally aspirated paper, has been put on hold pending resolution of some funding issues. Thus, the next paper probably won't be published until sometime in August.

Let me know if you would like us to send you drafts.

John

On Jul 1, 2016, at 9:00 AM, Charmley, William <charmley.william@epa.gov> wrote:

John,

I had the time this morning to read the technical paper from you, Aaron Isenstadt, and Mihai from Eaton.

I wanted to thank you and ICCT for doing this work. I think the paper is very well written and will be a good resource for many who are interested in the Mid-term Evaluation. I know you shared with Robin and Mike a schedule in May for other papers in this series. As I recall, the next few publications are going to be on

transmissions, mass reduction, and gasoline tubo engines. Can you let us know the schedule for those additional papers?

Thanks
Bill

Bill Charmley
Director
Assessment and Standards Division
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U.S. Environmental Protection Agency

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cell ph. 734-545-0333
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Cc: John German[john@theicct.org]; Nic Lutsey[nic@theicct.org]; Olechiw, Michael[olechiw.michael@epa.gov]; Moran, Robin[moran.robin@epa.gov]
To: Charmley, William[charmley.william@epa.gov]
From: Drew Kodjak
Sent: Fri 7/1/2016 1:45:53 PM
Subject: Re: ICCT working paper on naturally aspirated gasoline engines and deac.

Bill,
Thanks for your note; it's great to hear your positive reaction. You should also know that each of these shorter Technology Briefing papers will be published with a longer "working paper" that will go into greater depth on each major technology package. We expect that these working papers will be "endorsed" by one or more major suppliers that have served in an advisory capacity. Finally, I am talking with MECA about holding a large workshop on the Hill in September built around these themes described in the Technology Briefing series. The purpose of this workshop would be to bring the information to Congressional aides and staff, as well as a broader range of executive branch staff, media, etc.

Have a good 4th.

Drew

On Jul 1, 2016, at 9:00 AM, Charmley, William <charmley.william@epa.gov> wrote:

John,

I had the time this morning to read the technical paper from you, Aaron Isenstadt, and Mihai from Eaton.

I wanted to thank you and ICCT for doing this work. I think the paper is very well written and will be a good resource for many who are interested in the Mid-term Evaluation. I know you shared with Robin and Mike a schedule in May for other papers in this series. As I recall, the next few publications are going to be on transmissions, mass reduction, and gasoline tubo engines. Can you let us know the schedule for those additional papers?

Thanks
Bill

Bill Charmley
Director
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To: John German[john@theicct.org]
Cc: Drew Kodjak[drew@theicct.org]; Lutsey NIc[nic@theicct.org]; Olechiw, Michael[olechiw.michael@epa.gov]; Moran, Robin[moran.robin@epa.gov]
From: Charmley, William
Sent: Fri 7/1/2016 1:00:13 PM
Subject: ICCT working paper on naturally aspirated gasoline engines and deac.

John,

I had the time this morning to read the technical paper from you, Aaron Isenstadt, and Mihai from Eaton.

I wanted to thank you and ICCT for doing this work. I think the paper is very well written and will be a good resource for many who are interested in the Mid-term Evaluation. I know you shared with Robin and Mike a schedule in May for other papers in this series. As I recall, the next few publications are going to be on transmissions, mass reduction, and gasoline tubo engines. Can you let us know the schedule for those additional papers?

Thanks

Bill

Bill Charmley

Director

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e-mail: charmley.william@epa.gov

To: Moran, Robin[moran.robin@epa.gov]
From: Dave Cooke
Sent: Wed 6/22/2016 8:25:09 PM
Subject: RE: UCS Fact Sheet Series on the Midterm Review/2017-2025 regs

I have meetings scheduled from 2-4pm tomorrow but am otherwise free.

- Dave

From: Moran, Robin [mailto:moran.robin@epa.gov]
Sent: Wednesday, June 22, 2016 4:23 PM
To: Dave Cooke
Subject: RE: UCS Fact Sheet Series on the Midterm Review/2017-2025 regs

Hi Dave,

Thanks for sharing, this is good stuff. Sorry I haven't been able to return your call. Let me know if there's a good time tomorrow. Jeff may be calling you in meantime to talk about emissions reduction estimates.

Robin

From: Dave Cooke [mailto:DCooke@ucsusa.org]
Sent: Wednesday, June 22, 2016 12:18 PM
To: Charmley, William <charmley.william@epa.gov>; Alson, Jeff <alson.jeff@epa.gov>; Moran, Robin <moran.robin@epa.gov>; Olechiw, Michael <olechiw.michael@epa.gov>
Subject: UCS Fact Sheet Series on the Midterm Review/2017-2025 regs

EPA team,

I am sure you all are quite busy right now with your own MTE work, but I wanted to share some public-facing work that we at UCS have put together. Today we are kicking off a series of fact sheets discussing the 2017-2025 regulations and the mid-term review:

http://ucsusa.org/midtermreview

The first in the series are 1) a summary of the 2017-2025 standards and their benefits; 2) an explanation of why these rules are important as the market shifts to more SUVs and how they continue to bring benefits, regardless of consumer behavior; and 3) the technology that manufacturers have developed, spurred by these rules, and why it means they can go farther.

We will continue to update the series with other relevant topics (consumer benefits despite low gas prices, the role of advanced technologies, etc.) throughout the next couple months, announcing new fact sheets via blog. The first blog kicking off the series is available here: http://blog.ucsusa.org/dave-cooke/epa-nhtsa-vehicle-efficiency-standards-midterm-review.

If you have any questions/comments/concerns, I'd be happy to respond. Thanks,

- Dave

David W. Cooke, Ph.D.

Senior Vehicles Analyst

Union of Concerned Scientists

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To: Moran, Robin[moran.robin@epa.gov]
From: Charmley, William
Sent: Tue 6/21/2016 8:21:08 PM
Subject: FW: Technology Briefing papers - Publication of Naturally Aspirated Working Paper

Bill Charmley

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e-mail: charmley.william@epa.gov

From: John German [mailto:john@theicct.org]
Sent: Tuesday, June 21, 2016 10:52 AM
To: Charmley, William <charmley.william@epa.gov>; Olechiw, Michael <olechiw.michael@epa.gov>; Alson, Jeff <alson.jeff@epa.gov>; Alberto@ARB Ayala <Alberto.Ayala@arb.ca.gov>; Mike McCarthy <michael.mccarthy@arb.ca.gov>
Cc: Anup Bandivadekar <anup@theicct.org>; NIc Lutsey <nic@theicct.org>; Joe Schultz <joe@theicct.org>; Aaron Isenstadt <aaron.isenstadt@theicct.org>
Subject: Re: Technology Briefing papers - Publication of Naturally Aspirated Working Paper

FYI, we just published two papers on naturally aspirated gasoline engines. These are the first in a series of technology reports in support of the 2017-25 mid-term review. Reports on transmissions, gasoline turbocharged engines, lightweighting, and thermal management will (hopefully) be finished by September, with a report on diesels following by the end of the year.

The first paper is the detailed working paper that we did in collaboration with Eaton, BorgWarner, and ITB.

Working paper: <http://theicct.org/naturally-aspirated-gas-engines-201606>

The second is ICCT's technology "brief", which summarizes the results of the working paper and adds a bit about implications on the mid-term review.
Tech brief: <http://theicct.org/naturally-aspirated-engines-techbrief-jun2016>

Let me know if you have any questions or want additional information.

John

Cc: Olechiw, Michael[olechiw.michael@epa.gov]; Aaron Isenstadt[aaron.isenstadt@theicct.org]; Joe Schultz[joe@theicct.org]; Drew Kodjak[drew@theicct.org]
To: Moran, Robin[moran.robin@epa.gov]
From: John German
Sent: Thur 5/26/2016 1:02:53 AM
Subject: Re: Technology briefing series
Naturally Aspirated working paper v7a.docx
ATT00001.htm

Here is the schedule (although we are already behind). The goal is to get all of the papers done, except the diesel paper, before the end of the TAR comment period.
I have attached the latest draft of the naturally aspirated paper, although it will change as we are still negotiating with BorgWarner on the writeup. You are welcome to comment on it, but we will not acknowledge this, as we want to keep the technology papers independent of EPA, and I may not be able to incorporate all of your comments as everything has to be agreed with the participating suppliers.
1) Naturally aspirated gasoline paper.

- Initial draft has been distributed for review on April 1.
- Comments requested by May 2.

2) Transmission paper. ICCT is currently working on a complete draft for this paper. This was selected to go second because we have received most of the data, while we are still waiting for significant data and writeups on the other papers.

- Complete draft for review finished by ICCT - May 2 (Still not done.)
- Comments requested by June 1.

3) and 4) Lightweighting and gasoline downsized turbo papers. These will likely be our most important - and longest - papers, thus we want to get started on them after the transmission paper. We would like to work on them simultaneously, although this will be affected by when we receive data, information, and writeups.

- **Submit data, information, and initial writeups to ICCT by May 2.** (Still waiting for some inputs.)
- Complete drafts for review finished by ICCT by July 5.
- Comments requested by August 1.

4) Thermal Management. This was not one of the papers were originally planned. However, ITB volunteered to write the first draft, so we added it. Should be done before 3) and 4).

5) Diesel paper. While important, it is a lower priority than the other papers simply because of the relatively small share of the market.

- **Submit data, information, and initial writeups to ICCT by July 15.**
- Complete drafts for review finished by ICCT by September 1.
- Comments requested by October 1.

John

On May 25, 2016, at 8:52 AM, Moran, Robin <moran.robin@epa.gov> wrote:

Hi John,

Hope you're doing well. I'm glad you were able to join the NGOs' MTE meeting with EPA, NHTSA and CARB earlier this week, and appreciate all the good points you made on technology development.

Mike and I were hoping you could give us an update on the status of your technology briefing paper series, as we didn't catch everything you said on Monday's call. I know the hybrid paper is on your web. Are there others ready in draft form? We'd be glad to take a look at any drafts, if that's something you'd find useful. We thought we heard you say the papers were targeted for completion in Sept – is that right?

Thanks John.

Take care,
Robin

Robin Moran
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Ann Arbor, MI 48105
(734) 214-4781 (phone)
(734) 214-4821 (fax)

To: Lutsey Nic[nic@theicct.org]; Drew Kodjak[drew@theicct.org]; John German[john@theicct.org]; tlanger@aceee.org[tlanger@aceee.org]; rhwang@nrdc.org[rhwang@nrdc.org]; Ltonachel@nrdc.org[Ltonachel@nrdc.org]; Dave Cooke[DCooke@ucsusa.org]; Jonna Hamilton[JHamilton@ucsusa.org]; Chester France[cjfrance@sbcglobal.net]; Michelle Robinson[MRobinson@ucsusa.org]
Cc: Moran, Robin[moran.robin@epa.gov]; Olechiw, Michael[olechiw.michael@epa.gov]
From: Charmley, William
Sent: Mon 5/23/2016 10:36:55 AM
Subject: Recent technical paper updates to EPA's Mid-term Evaluation web-page

Dear all –

(note, I could not find an email for Siddiq Khan at ACEEE, could someone please forward this to Siddiq)

I believe most of you are aware that in late 2014 EPA/OTAQ established a web-site as part of the OTAQ web pages specific to the light-duty Mid-term Evaluation process.

https://www3.epa.gov/otaq/climate/mte.htm

I wanted to let all of you know of several recent updates to the material available on EPA's MTE page. I have copied below the new links directly from the web-site. The text in red is just for you.

The most significant updates are 7 new peer-reviewed papers that EPA staff published/presented at the Society of Automotive Engineer's 2016 World Congress last month in Detroit.

All of these are excellent technical papers, but in particular I would highlight 2 papers:

•□□□□□□□□ New! "Estimating GHG Reduction from Combinations of Current Best-Available and Future Powertrain and Vehicle Technologies for a Midsized Car Using EPA's ALPHA Model," SAE Technical Paper 2016-01-0910, 2016, doi:10.4271/2016-01-0910, Kargul, J., Moskalik, A., Barba, D., Newman, K., and Dekraker, P. (PDF) (16 pp, 1.0MB, May 4, 2016)

•□□□□□□□□ New! "Air Flow Optimization and Calibration in High-Compression-Ratio Naturally Aspirated SI Engines with Cooled-EGR," SAE Technical Paper 2016-01-0565, 2016, doi:10.4271/2016-01-0565, Lee, S., Schenk, C., and McDonald, J. (PDF) (10 pp, 997K, May 4, 2016)

The first paper is an assessment that is basically in-line with the 2015 NAS report assessment that a mid-size car can achieve it's 2025 target without electrification (beyond start/stop), but informed by EPA's more recent technical updates for engines and transmissions.

The second paper is a modeling assessment informed by detailed laboratory data of the potential efficiency improvements from the use of cooled EGR and cylinder-deactivation to an Atkinson-cycle engine. We believe the overall results of such a technology approach are very promising.

Please let Robin Moran, Mike Olechiw or I know if you have any questions regarding this technical work.

Best regards,

Bill

•□□□□□□□□ Through EPA's National Center for Advanced Technology (NCAT) group, we are researching future advanced engine and transmission technologies (PDF) (19 pp, 1.67MB) to support modeling, advanced technology testing, and demonstrations

[links to the EPA 2016 SAE Government-Industry presentation on ALPHA & benchmarking]

•□□□□□□□□ In addition to working with CARB and NHTSA, EPA is collaborating with DOE on projects involving vehicle light-weighting and battery cost modeling, and Environment and Climate Change Canada/Transport Canada on projects involving aerodynamics, vehicle light-weighting, all-wheel drive vehicles, and other areas.

[updates Environment Canada and Climate Change's new name/updated link, and links to Transport Canada's study on pickup truck mass/safety]

EPA Publications Informing the Midterm Evaluation

NOTE: You will need Adobe Acrobat Reader, available as a free download, to view some of the files on this page. See EPA's PDF page to learn more about PDF, and for a link to the free Acrobat Reader.

Throughout the MTE process, EPA's goal is to publish as much of our research as possible in peer-reviewed journals. EPA staff have published the following peer-reviewed papers so far since 2013.

•□□□□□□□□ New! "Air Flow Optimization and Calibration in High-Compression-Ratio Naturally Aspirated SI Engines with Cooled-EGR," SAE Technical Paper 2016-01-0565, 2016, doi:10.4271/2016-01-0565, Lee, S., Schenk, C., and McDonald, J. (PDF) (10 pp, 997K, May 4, 2016)

•□□□□□□□□ New! "Fuel Efficiency Mapping of a 2014 6-Cylinder GM EcoTec 4.3L Engine with Cylinder Deactivation," SAE Technical Paper 2016-01-0662, 2016, doi:10.4271/2016-01-0662, Stuhldreher, M. (PDF) (7 pp, 919K, May 4, 2016)

•□□□□□□□□ New! "Estimating GHG Reduction from Combinations of Current Best-Available and Future Powertrain and Vehicle Technologies for a Midsized Car Using EPA's ALPHA Model," SAE Technical Paper 2016-01-0910, 2016, doi:10.4271/2016-01-0910, Kargul, J., Moskalik, A., Barba, D., Newman, K., and Dekraker, P. (PDF) (16 pp, 1.0MB, May 4, 2016)

•□□□□□□□□ New! "Benchmarking and Hardware-in-the-Loop Operation of a 2014 MAZDA SkyActiv 2.0L 13:1 Compression Ratio Engine," SAE Technical Paper 2016-01-1007, 2016, doi:10.4271/2016-01-1007, Ellies, B., Schenk, C., and Dekraker, P. (PDF) (8 pp, 782K, May 4, 2016)

•□□□□□□□□ New! "Modeling of a Conventional Mid-Size Car with CVT Using ALPHA and Comparable Powertrain Technologies," SAE Technical Paper 2016-01-1141, 2016, doi:10.4271/2016-01-1141, Newman, K., Doorlag, M., and Barba, D. (PDF) (13 pp, 1.0MB, May 4, 2016)

•□□□□□□□□ New! "Investigating the Effect of Advanced Automatic Transmissions on Fuel Consumption Using Vehicle Testing and Modeling," SAE Int. J. Engines 9(3):2016, doi:10.4271/2016-01-1142, Moskalik, A., Hula, A., Barba, D., and Kargul, J. (PDF) (13 pp, 1.0MB, May 4, 2016)

•□□□□□□□□ New! "Modeling the Effects of Transmission Gear Count, Ratio Progression, and Final Drive Ratio on Fuel Economy and Performance Using ALPHA," SAE Technical Paper 2016-01-1143, 2016, doi:10.4271/2016-01-1143, Newman, K. and Dekraker, P. (PDF) (16 pp, 2.0MB, May 6, 2016)

EPA Presentations Regarding the Midterm Evaluation

EPA also has publicly presented information about our work in numerous forums (selected presentations below):

New! - "Modeling Methodology for EPA GHG Analysis," presented at the joint NHTSA-EPA-CARB Workshop on Technology Effectiveness Modeling Methodologies, March 1, 2016. (PDF) (54 pp, 6.36MB)

New! - "ALPHA Effectiveness Modeling: Current and Future Light-Duty Vehicle & Powertrain Technologies," January 20, 2016.(PDF) (19 pp, 1.67MB)

Working Paper

Technology Brief #2: Naturally aspirated gasoline engines and cylinder deactivation

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Eaton: Mihai Dorobantu
BorgWarner: David Lancaster and Erika Nielsen

Acknowledgement:
ICCT thanks Sean Osborne and Joel Kopinsky from the ITB Group for their reviews.

Summary:

Table 1: Naturally aspirated engine technology compared to EPA/NHTSA 2017-2025 rulemaking (RM)

Ahead of RM On Schedule Behind RM	Stop-start	Gasoline Direct Injection	High Compression ratio	Cylinder Deactivation	Atkinson Cycle
Cost			n/a		n/a
Penetration					
Benefits					

Table 1, above, summarizes the latest assessment of future technology penetration, cost, and fuel consumption reductions compared to the technology assessments in the 2017-25 rulemaking ("RM"). Overall, the main naturally aspirated technologies are all on track or ahead of the assessments in the 2017-25 rulemaking. For example, Figure 1, below, illustrates that various technologies are penetrating the fleet at a more rapid rate than was projected by the Agencies in their rulemaking assessment, although this may be influenced by the desire of manufacturer's to accumulate as many CO2 credits as possible as standards become increasingly more stringent. The fuel economy of vehicles with naturally aspirated engines is also improving more rapidly than was projected by the agencies in the 2017-25 rulemaking and costs are comparable or coming down.

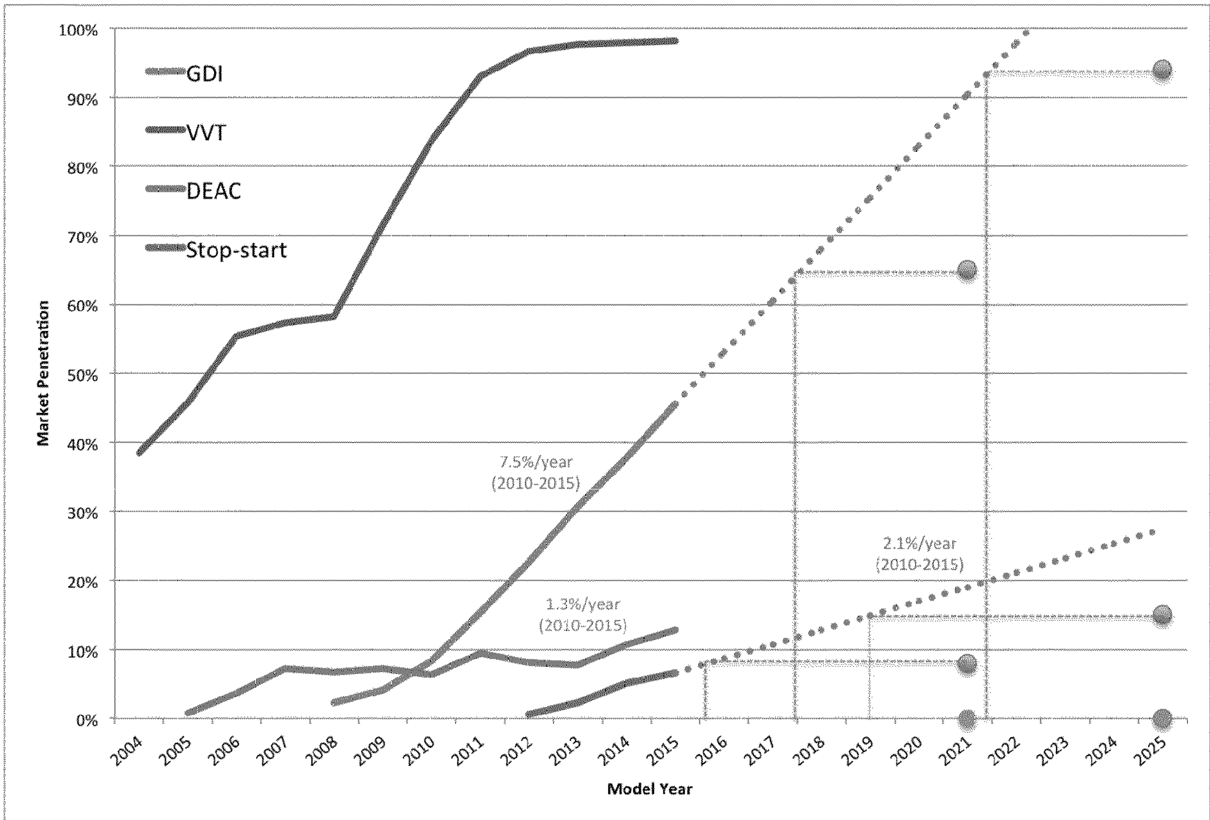


Figure 1: Market penetration of select technologies, and extrapolation to rulemaking projected penetration

One striking aspect of the 2017-25 rulemaking projections is that EPA/NHTSA projected that naturally aspirated engines would be gradually displaced by "boosted" gasoline engines over model years 2017-2025. The Agency's projections followed a simple logic: In 2012, trends in technologies that improved fuel economy suggested that downsized, turbocharged engines would be the most cost-effective solution. Thus, the Agencies projected that boosted gasoline engines would capture 64% of the market in 2021 and 93% in 2025. Only 5% of 2025 vehicles would have naturally aspirated engines, and these would all be Atkinson cycle engines used in full hybrid vehicles.

However, the fuel economy of naturally aspirated vehicles is improving more rapidly than was projected by the agencies in the 2017-25 rulemaking. The continuous cycle of vehicle innovation is driving these improvements - such as the extremely high compression ratio in Mazda's SkyActiv engine; the individual cylinder deactivation in GM engines with Dynamic Skip Fire; and Toyota's introduction of an improved, Atkinson-cycle engine on non-hybrid vehicles.

The key enabling technology for both high compression ratio engines and dynamic cylinder deactivation is variable valve timing (VVT) and lift (VVL) control. VVT/VVL systems that already exist for Atkinson cycle and high compression ratio engines would require only minor modifications to enable a zero lift cam profile for cylinder deactivation. The resulting engine may be capable of cylinder deactivation, Atkinson cycle, and have high compression ratio. Cooled EGR can enable further increases in compression ratio and efficiency. Specific engine loading would determine which strategy best optimizes fuel consumption.

Vehicle manufacturers are developing and deploying fuel-saving technologies at a faster clip than regulators anticipated - and at lower cost. Based on the success of Mazda and Toyota, it is clear that the goal of good performance and fuel economy can be reached with high compression ratio engines that permit various degrees of valve control. Naturally aspirated engines cannot compete with the substantial cost savings in replacing the two cylinder heads of a V-configuration engine with an inline 4-cylinder turbocharged engine, but the cost benefits of engine downsizing are greatly reduced when starting with an inline engine. Thus, these naturally aspirated engine improvements give manufacturers and suppliers another option/pathway for current 4-cylinder engines tocomply with the 2025 standards. Although different manufacturers will use different technology solutions, these improvements provide a potentially lower cost component to supplement manufacturers' efforts to meet aggressive CO_2 regulations on up to roughly 25% of the fleet.

Introduction:

In 2012, the U.S. Environmental Protection Agency (EPA) and the Department of Transportation's National Highway Traffic Safety Administration (NHTSA) finalized a joint rule establishing new greenhouse gas and fuel economy standards for vehicles. The new standards apply to new passenger cars, light-duty trucks, and medium-duty passenger vehicles, covering model years 2012 through 2021, with a mid-term review in 2017.

Assuming the fleet mix remains unchanged, the standards require these vehicles to meet an estimated combined average fuel economy of 34.1 miles per gallon (mpg) in model year 2016, and 49.1 mpg in model year 2025. The standards require an average improvement in fuel economy of about 4.1 percent per year. As the technology assessments conducted by the Agencies in support of the 2017-25 rule were conducted about 5 years ago, the ICCT is collaborating with suppliers to publish a series of working papers evaluating technology progress and new developments in engines, transmissions, vehicle body design and lightweighting, and other measures. Each technology brief will evaluate:

- How the current rate of progress (cost, benefits, market penetration) compares to projections in the rule
- Recent technology developments that were not considered in the rule and how they impact cost and benefits
- Customer acceptance issues, such as real-world fuel economy, performance, drivability, reliability, and safety.

This paper provides an analysis of naturally aspirated gasoline engine technology development and trends since the analyses performed about 5 years ago by the Agencies in support of the 2017-25 rule. It is a joint collaboration between ICCT and **[insert names of public supplier participants].** The paper relies on data from publicly available sources and data and information from the participating automotive suppliers.

Background:

Technology description: How does it improve efficiency?

The internal combustion engine ("ICE") is designed to convert chemical energy (fuel) into kinetic energy (motion of the vehicle). Direct losses in engine efficiency are due to the inherent thermal efficiency, intake and exhaust pumping losses, friction within the engine, and engine-driven accessory losses. The biggest inefficiencies arise from thermal efficiency limits and intake & exhaust pumping losses. Hence, reducing the impact of these sources of loss is the focus of this briefing.

ICEs are heat engines. Gas heated by combustion in the cylinder is used to do work in turning a crankshaft that powers the vehicle. Heat losses are by far the largest losses in the engine, with roughly 60% of the energy from the fuel lost to heat: about half of that heat is lost to the cooling system and the other half to the exhaust. A wide variety of technologies and engine designs can increase thermal efficiencies, i.e. decrease heat loss, by modifying the gas pressure, temperature and volume. Two major examples of this are increasing compression ratio (or expansion ratio), and using alternative thermodynamic cycles (such as Atkinson).

Gasoline engines use a spark to ignite the hot, high-pressure gas for combustion. Controlling the air and fuel flow regulates load. When the engine is not driven at its designed maximum power, it requires less air and the engine's throttle regulates air mass flow. The throttle is almost always at least partially closed to ensure the proper amount of air is aspirated and it takes work to force air past the partially closed throttle. This work is referred to as pumping losses. There are a multitude of ways to reduce pumping losses, such as increasing exhaust gas recirculation, variable valve timing, cylinder deactivation, and downspeeding the engine.

All moving parts inside the engine exhibit friction at their interfaces, which must be overcome. The main frictional losses in the engine are due to piston contact with cylinder walls, the valvetrain, and crankshaft. Better lubrication, surface coatings, and part redesign reduce friction. Additionally, a number of control strategies offer friction and pumping loss reductions.

Accessory losses are due to devices which are powered by the engine but do not contribute to vehicle motion, such as the air conditioning compressor, fans, pumps, alternator, etc. Except for the air conditioning compressor, which is only used during hot weather, these losses typically are relatively low compared to other losses in efficiency. There are many ways to reduce these losses, some of which are discussed in the companion Technology Brief on Thermal Management (forthcoming).

An engine's valves control the flow of air, fuel and exhaust into and out of an engine's combustion chambers. During normal operation, these valves open and close from 10 to 100 times per second. Historically, controlling such rapid valve movement required a rotating metal camshaft with fixed lobes. The camshaft timing and lift determines when and by how much the intake and exhaust valves open and close.

Variable valve timing (VVT) and variable valve lift (VVL) offer greater control over the air entering the engine. VVT allows the timing of valve opening and closing to be varied. More sophisticated systems also allow the length and/or height of the valve opening to be varied (VVL). At low engine loads they permit the throttle to open further, reducing pumping losses. At high loads they increase airflow for more power, enabling engine downsizing and/or engine downspeeding for additional efficiency improvements. VVT can also be used to control levels of residual exhaust gases, providing additional combustion improvements and pumping loss reductions.

VVL/VVT also facilitate the use of more efficient combustion cycles, such as the **Atkinson cycle.** An Atkinson cycle engine trades off decreased power for increased efficiency.. Essentially, the intake valve remains open for a longer duration on the intake stroke and closes during the normal compression stroke. This results in an effective compression ratio that is less than the expansion ratio during the power stroke, and allows the geometric compression ratio to be increased. This allows more work to be extracted per volume of fuel as compared to a typical Otto cycle engine. However, due to a smaller trapped air mass (a consequence of air being forced out of the intake valve early in the compression stroke), the power density in the Atkinson cycle is lower than in the Otto cycle, although increasing the compression ratio can partially compensate for this drawback.

Cylinder deactivation allows the engine to significantly reduce pumping and heat transfer[1] losses at lower engine loads by reducing the number of running active cylinders and increasing the load on these cylinders. This reduces active displacement, thus increasing manifold pressure and reducing pumping losses through a lower pressure differential across the engine. It also increases the load on the cylinder, or brake mean effective pressure (BMEP), which reduces the heat transfer to the cylinder walls and head as a percent of the fuel energy.[1]

Since these and other technologies, such as turbocharging and more transmission gears, can achieve similar reduction in pumping and friction losses, the specific engine configuration determines the effectiveness of individual technologies. For example, implementing cylinder deactivation on an engine already equipped with VVT will not necessarily achieve the same efficiency gains as implementation on an engine without VVT.

Technology history and Market Penetration trends (passenger vehicles, including light trucks)

[1] Increased load in the cylinder, or brake mean effective pressure (BMEP), reduces the heat transfer to the cylinder walls and head as a percent of the fuel energy. See for example, Engine Heat Transfer Engine Heat Transfer - MIT, slide 19. *http://web.mit.edu/2.61/www/Lecture%20notes/Lec.%2018%20Heat%20transf.pdf*

Naturally aspirated gasoline engines have been used for well over a hundred years. The traditional Otto-cycle gasoline engine has gradually improved over time, but the basic structure remained remarkably similar from the 1890s to the 1970s. A fixed, single camshaft drove the valves, a carburetor mixed fuel with air before the intake manifold, and a coil delivered electricity to the spark plugs, with spark timing controlled by a distributor. All parts were controlled mechanically. Most engines were 4-stroke engines, with separate intake, compression, expansion, and exhaust phases over two revolutions of the engine.

The first major changes were driven to a large extent by emission standards in the 1960s and 1970s. Initially, exhaust gas recirculation (EGR) was introduced to reduce engine-out NO_x emissions. With the invention and subsequent availability of microprocessors, rudimentary computers were introduced to improve control of fuel delivered to the carburetor and reduce HC and CO emissions. The next step was development of the oxygen sensor, which was needed to improve air/fuel control and optimize three-way catalyst efficiency. This was followed by development of fuel injection to replace the carburetor. Fuel injection allowed much more precise control of the fuel delivered to the engine and balancing of cylinder-cylinder fueling. Not only did it decrease emissions and improve catalyst efficiency, it offered opportunities to optimize combustion chamber design and increase compression ratio. Computer controls also enabled the rapid penetration of fuel injection, from only 6% of vehicles in 1980 to virtually all vehicles by 1990.[1]

Technology improvements have been coming at an ever-increasing rate, enabled by the development of computer-aided design and electronic controls. In the last thirty years, four-valve engines, turbocharging, hybrids, cylinder deactivation, variable valve timing and lift, gasoline direct injection and stop-start systems have all seen introduction and growth in the mass market.. Several of these improvements are summarized in Table 2, below:

Table 2: Penetration rates of select technologies cars & light trucks. SOURCE: 2015 FE trends report.[1]

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
GDI	-	-	-		2.3%	4.2%	8.3%	15.4%	22.6%	30.7%	37.7%	45.6%
VVT	38.5%	45.8%	55.4%	57.3%	58.2%	71.5%	83.8%	93.1%	96.7%	97.7%	97.9%	98.2%
DEAC	-	0.8%	3.6%	7.3%	6.7%	7.3%	6.4%	9.5%	8.1%	7.7%	10.7%	12.8%
Multi-valve	62.3%	65.6%	71.7%	71.7%	76.4%	83.8%	85.5%	86.4%	91.9%	93.1%	89.4%	89.4%
Stop-start	-	-	-	-	-	-	-	-	0.6%	2.3%	5.1%	6.6%

GDI: gasoline direct injection; VVT: variable valve timing; DEAC: cylinder deactivation; Multi-valve: 3 or more valves per cylinder; 2015 values are estimates

According to the 2015 EPA fuel economy trends report [2], gasoline direct injection exhibited a rapid increase in market penetration from virtually zero to 45.6% in just 7 years, replacing port fuel injection. Growth is expected to continue, since DI offers several benefits over port injection (most notably cylinder cooling through fuel vaporization inside the cylinder, which enables higher compression ratios with reduced risk of knocking). Indeed, GM and Ford each have GDI in well over 50% of their respective production (see fig. 4.1 of the EPA FE Trends report), and Toyota and FCA are increasing their shares.[3]

The decrease in market share of multivalve cylinders since 2013 is largely due to the increase in truck sales using two-valve DI engines with VVT (see Fig. 5.1 of the EPA FE Trends report).

By 2012, virtually all passenger vehicles used variable valve timing. And the vast majority of VVT was on multivalve cylinders.

Cylinder deactivation (DEAC) also grew in market share. GM and Honda both project DEAC in over 25% of their respective production. Fleetwide, approximately 27.4% of light trucks are estimated to use DEAC in 2015, although only 2.7% of cars used the technology. This is likely because conventional cylinder deactivation is easier to implement on cam-in-block V6 and V8 engines widely used on light trucks than on the 4-cylinder engines that dominate car sales. Conventional cylinder deactivation involves shutting off half, or an even number of, an engine's cylinders. As described below, advances in cylinder deactivation strategies that are in development will permit a much wider range of engines to reap the fuel economy benefits and will also increase those benefits.

Historical estimates of technology costs and benefits

Table 3: Historical estimates of selected technology fuel consumption reduction benefits and direct manufacturing costs (DMC)

	NAS 2002		NHTSA 2008-2011		EPA/NHTSA 2017-2025	
GDI	4-6%	n/a	1-3%	$200-250	1-3%	$164-296
DEAC	3-6%	$112-252	3-6%	$116-262	0.5-6.5%	$118-133
VVT	2-3%	$35-140	2-3%	$36-146	1-5.5%	$31-124
VVL	1-2%	$70-210	1-2%	$73-218	2.8-4.9%	$99-296
IVT	3-6%	$210-420	3-6%	$218-437	-	-
CVA	5-10%	$28-560	5-10%	$291-582	-	-

GDI: gasoline direct injection; DEAC: cylinder deactivation; VVT: variable valve timing; VVL: variable valve lift; IVT: electromechanical intake valve throttling; CVA: camless valve actuation

A National Academy of Sciences (NAS) Committee issued an excellent report on fuel economy in 2002, including projected technology benefits and cost.[4] The report was widely used for many years, including serving as the starting point for NHTSA's light truck CAFE standards for 2005-2007. We utilize it here because it captured the status of technology development in 2002 and, thus, illustrates the technology innovations that have occurred since then.

According to the NAS 2002 report, cylinder deactivation (DEAC) would realize a 3-6% decrease in fuel consumption at a cost of $112-252. The NHTSA 2008-2011 RIA[5] used this estimate virtually unchanged. Note that the 2025 estimated cost for DEAC is within, but near the lower bound, of the range predicted in the NAS 2002 report. In that report, the predictions were made out to 2015. In the EPA/NHTSA joint TSD, the cost for DEAC in 2015 was $146-165, squarely within the range estimated in NAS 2002.

Gasoline direct injection ("GDI") requires new injector designs, high pressure fuel pump & rails, new piston crown/cylinder head design, and other changes to improve mixing (or stratification). DI can improve knock resistance, allowing higher compression ratios. NAS 2002 did not estimate costs for GDI, but did estimate that it would have a 4-6% decrease in fuel consumption. The 2008-2011 RIA cut the fuel consumption reduction to 1-3% and estimated a cost of $200-250. This reduced benefit of GDI may be due to the increased part-load intake pumping losses incurred with direct injection. DI requires more energy to pump the fuel to higher pressure for in-cylinder injection. Also, combustion efficiency can decrease compared to port fuel injection (PFI). Consequently, the main benefit of GDI by itself over PFI on naturally aspirated engines is control over injection timing, which provides cooling of the air/fuel mixture in the cylinder and enables faster catalyst light-off. There are additional benefits when GDI is combined with VVT/VVL and, especially, turbocharging.

VVT and VVL encompass a number of different methods to vary valve duration, occurrence and lift. For example cam phasing, the simplest form of VVT, changes the relationship of the rotation (angle) of the camshaft with respect to the rotation of the crankshaft. But even here there are various versions with different benefits and costs, from a simple change of all timing for an engine with a single camshaft (CCP), to varying just the intake phasing for an engine with dual camshafts (ICP), to varying both the intake and exhaust phasing for an engine with dual camshafts (DCP). For VVL, one option is to use multiple lobes/cam profiles fixed to the camshaft with multiple finger followers that lock together or work separately based on the engine's load. Alternatively, a single follower may be used with a multi-lobe cam that axially slides on the camshaft to select the appropriate lobe/profile (cam profile switching, "CPS"). According to NAS 2002, VVT would result in a fuel consumption reduction of 2-3% at a cost of $35-$140. Both the 2008-11 and 2017-25 rulemaking estimates were similar. NAS 2002 also estimates that VVL would result in 1-2% fuel consumption reduction over cam phasing (VVT) on 4-valve engines (5-10% on two-valve engines) at a cost of $70-210. While the 2008-11 RIA appears to have used the NAS estimates, the estimated benefits for the 2017-25 rule were over twice as high, although at somewhat higher cost.

Intake valve throttling (IVT), a more advanced form of VVL, could remove the need for the throttle plate entirely. IVT essentially uses the intake valves themselves to throttle intake air. The 2002 NAS report and the 2008-11 RIA estimated this would result in 3-6% fuel consumption reduction over VVL, costing $210-437. It is worth noting that, to date, no IVT or VVL strategy, even BMW's Valvetronic or Fiat's MultiAir, has completely eliminated the throttle. This is due to the necessity of a torque reserve: additional torque must be available to the driver in case it is needed. The throttle builds up pressure for this torque reserve and improves air distribution to the cylinders.

NAS 2002 also predicted that camless valve actuation (CVA), would result in an additional 5-10% fuel consumption reduction beyond VVTL at a cost of $280-560. The 2017-2025 rulemaking did not explicitly consider either IVT or CVA, although it did consider more advanced forms of VVL, as discussed in the next section.

EPA/NHTSA 2017-2025 projections: market penetration, costs, and benefits

Table 4: EPA/NHTSA market projections and direct manufacturing costs

	2015 penetr.	2021 penetr.	2025 penetr.	Direct Manufacturing Cost (2025)	Fuel consumption reduction
GDI	46%	65%	94%	$164 (I3/4), $246 (V6), $296 (V8)	1-3%
DEAC	13%	1-9%	1-5%	$118 (V6), $133 (V8)	0.5-6.5%
VVT - ICP	98%	2%	2%	$31(OHC-I4),$63(OHC-V6/8)	2.1-2.7%
VVT - CCP		11%	11%	Same as above	1-3%
VVT - DCP		70%	70%	$58(OHC-I4),$124(OHC-V6/8)	4.1-5.5%
DVVL	n/a	12-52%	11-52%	$99(OHC-I4),$143(V6),$204(V8)	2.8-3.9% (v VVT)
CVVL		16%	16%	$148 (I4), $271 (V6), $296 (V8)	3.6-4.9% (v VVT)
Stop-start	7%	8%	15%	$225-279	1.8-2.4%
IACC	n/a	68%	67%	$97	3.1-3.9%
Atkinson cycle	2.5%	4%	5%	n/a	8.0-10.3%

GDI: gasoline direct injection; DEAC: cylinder deactivation; VVT: variable valve timing; ICP: intake cam phasing; CCP: coupled cam phasing; DCP: dual cam phasing; DVVL: discrete VVL; CVVL: continuous VVL; IACC: electric accessory improvement

Table 4 summarizes the technology assessments in the 2017-25 rulemaking relevant to naturally aspirated engines. These estimates are the baseline used for the technology assessments in this paper. Note that all of the Agencies' cost estimates are Direct Manufacturing Costs (DMC). Figure 2 illustrates some of these estimates on an engine schematic. The first column, labeled "2015 penetration" lists the estimated market penetration of select technologies from EPA's fuel economy trends report.[1] Subsequent columns are projections from the rulemaking. The 2015 Atkinson penetration estimate was obtained using Ford's and Toyota's market share of hybrids, as these were the only vehicles in 2015 to use Atkinson cycle.

Stop-start reduces fuel consumption in urban driving by shutting the engine off when the vehicle comes to a stop (in traffic), and restarting when acceleration is required, effectively slashing engine idling time. In the RM, the technology that actually shuts off the engine and restarts it includes an improved 12v starter (higher power and longer cycling life) and a larger and more capable battery. The resulting benefits of this improved starter are 1.8-2.4% fuel consumption reduction.

However, the agency's also considered adding two levels of accessory improvement to the 12v stop-start system ("IACC1" and "IACC2"). IACC1 replaces the vehicle's alternator with another of high efficiency (70% efficiency). IACC2 adds "mild regenerative alternator strategy" to the high efficiency alternator and "intelligent cooling". The combination of the two was estimated to cost $97 in 2025 and have an effectiveness of 3.1-3.9% relative to no accessory improvements. The combination of stop-start and IACC1 & IACC2 achieves 4.8-5.9% fuel consumption reduction.

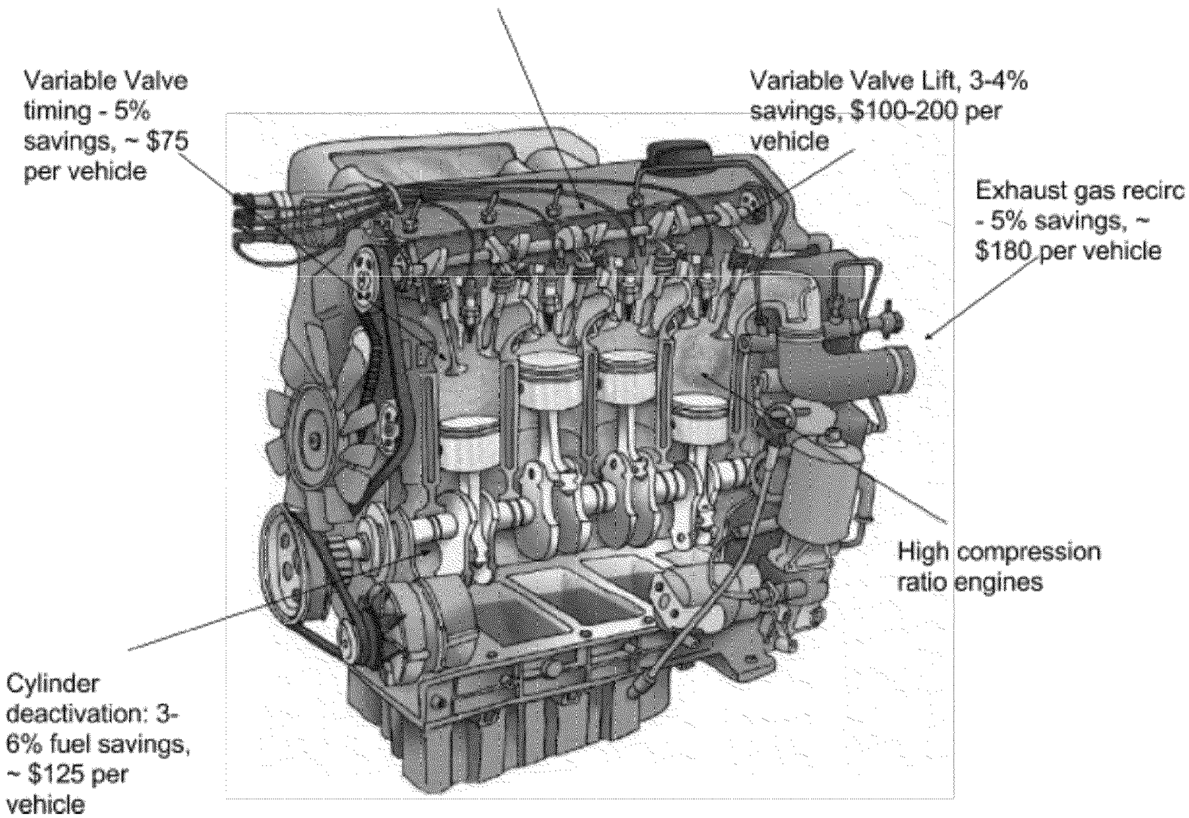


Figure 2: Engine schematic showing 2017-2025 estimated direct manufacturing costs ("DMC") and percent fuel consumption reduction

One striking aspect of the 2017-25 rule analyses is that the Agencies projected that naturally aspirated engines would be gradually displaced by "boosted" gasoline engines over model years 2017-2025. The Agency's projections followed a simple logic: In 2012, trends in technologies that improved fuel economy suggested that downsized, turbocharged engines would be the most cost-effective solution. Thus, the Agencies projected that boosted gasoline engines would capture 64% of the market in 2021 and 93% in 2025. Only 5% of 2025 vehicles would have naturally aspirated engines, and these would all be Atkinson cycle engines used in full hybrid vehicles.

As shown in Table 4, above, GDI already occupies a large market share and the 2017-2025 rulemaking projected the share would continue to grow through 2025. This is consistent with the projected increase in boosted engines, as all boosted engines are expected to use

GDI.

Depending on the valvetrain configuration already present in a vehicle, the agencies determined that cylinder deactivation could have between 0.5% and 6.5% reduction in fuel consumption. The low end of the range is mainly due to the overlap in the reduction of pumping losses inherently present in advanced valvetrains, such as dual-overhead cam (DOHC) engines with dual cam phasing (DCP) and DVVL & EGR.[2] However, according to the rulemaking, the cost of adding cylinder deactivation to these advanced valvetrains is also very low - a minimum of $32 when added to an engine with VVL, which accounts for active engine mounts to improve NVH. For engines with no application of VVT or VVL, DEAC benefits increase to 4.7-6.5% at a cost of $118-$131. These estimates are all for conventional cylinder deactivation that shuts off half, or an even number of, an engine's cylinders. More advanced systems were not considered.

The rulemaking considers two main methods of cylinder deactivation. For overhead cam engines, the rocker arm (finger-follower) has one part that follows a cam lobe/profile, and another that opens its respective valve (termed "DEACS" for single overhead cams in the rulemaking, "DEACD" for dual overhead cams). A lashing or latching mechanism either connects or disconnects these two parts, thereby activating or deactivating the valve and its cylinder (see [6] or [7], e.g.). For overhead valve engines (pushrod), solenoids release hydraulic oil pressure in the tappet, collapsing the lifters and deactivating the respective pushrods and valves (termed "DEACO" in the rulemaking). The rulemaking cost estimation given in Table 4 for DEAC assumes these two technology options. The agencies also mention, but do not consider a third method, which is to use a zero-lift cam lobe and switch to this lobe to deactivate the valves.

The agencies considered three types of VVT: intake cam phasing (ICP), coupled cam phasing (CCP), and dual cam phasing (DCP). All three use a cam phaser to adjust the phase (angular position) of the camshaft(s) relative to the crankshaft. Most cam phasers in production are hydraulically-actuated: a solenoid controls engine oil pressure applied to the cam phaser.

- ICP is generally applicable only to DOHC engines and controls only the intake valve timing, while exhaust valve timing is fixed.
- CCP controls intake and exhaust valve timing in equal amounts. The agencies assumed that overhead valve (OHV) engines cannot use any other cam phasing strategy, although this is not strictly true since OHV engines can use a special cam and phaser, as evidenced by the Dodge Viper (albeit at a much higher cost.)
- DCP is generally applicable only to DOHC engines, but allows for greater flexibility in valve timing control.

The rulemaking also considers two types of variable valve lift (VVL): discrete VVL (aka cam profile switching (CPS)), and continuous VVL.

- DVVL switches between two, or possibly three, discrete camshaft profiles. It is

[2] It is possible that the Agencies failed to consider the heat transfer improvements with the higher BMEP created by cylinder deactivation.

considered a mature technology with low risk, and is applied only on overhead cam vehicles.
- CVVL offers greater effectiveness than DVVL since it can be optimized for any load. BMW valvetronic and Fiat MultiAir are two systems currently in production that offer CVVL.

Atkinson cycle efficiency was modeled by Ricardo for EPA. EPA post-analyzed Ricardo's simulation runs and apportioned the losses and efficiencies to six categories—engine thermal efficiency, friction, pumping losses, transmission efficiency, torque converter losses, and accessory losses. These losses and efficiencies were incorporated into EPA's Lumped Parameter Model (LPM, [8]). Ricardo did not model a baseline Atkinson cycle engine, so the only estimates in the LPM are for a 2025 Atkinson cycle engine. Selecting Atkinson cycle in the LPM results in a reduction in fuel consumption of 8.0-10.3% for the 2025 Atkinson cycle compared with a baseline conventional engine, depending on the vehicle class. Unfortunately, the Agencies did not break out the cost of the Atkinson cycle engine, but there is no technical reason why the cost should be significantly different from an engine with VVT and VVL.

Status of current production versus Agency projections

High Compression Ratio Engines

Increasing compression ratio improves thermal efficiency. High compression ratios are necessary on naturally aspirated engines to reduce fuel consumption without the additional costs of turbo- and supercharging. However, increasing compression ratio also increases the risk of knocking, where unburned mixture ahead of the flame front ignites before the propagating flame engulfs it.

Mazda SkyActiv-G (gasoline) engines resolve the knocking problems and achieve one of the highest advertised compression ratios of any production gasoline engine.[9] In the US, the advertised CR is limited to 13.0:1 due to lower octane fuel, but in the EU, the engine achieves an advertised 14.0:1 CR.

This remarkably high compression ratio and fuel-efficient[10] 2.0-L 4-cylinder engine was realized by engineering successive improvements into the engine. This allowed Mazda's SkyActiv-G engine to achieve a 15% reduction in fuel consumption on NEDC (European drive cycle) at a relatively low cost.[8] The US FTP city cycle is considerably more stringent than the NEDC and the US highway cycle is quite different, so the fuel consumption reduction on the US cycles may differ substantially. In the US, the MY2014 Mazda6 achieved about 25% reduction in fuel consumption compared to the MY2013 Mazda6 (the MY2016 Mazda6 already meets MY2021 fuel economy standards.[11]), although this dramatic reduction includes other, non-engine, technologies implemented by Mazda in their full redesign. For example, the road load HP at 50mph dropped by 23-32% from 2013 to 2014 depending on which coefficients from the EPA data you use. The test weight also dropped from 3625 to 3500. These load reductions likely account for about half of the fuel economy improvements, leaving 10-15% for the engine improvements.

The Mazda SkyActive engine utilizes the Atkinson cycle concept with direct injection and a combustion chamber optimized with high tumble flow and a small bore. A fabricated 4-2-1 exhaust manifold is used to minimize residual fraction and ensure a cool in-cylinder charge. Combined with other engine improvements, torque was increased by 15% (Figure 3). Delayed intake valve closing and dual VVT reduce pumping losses 20%.

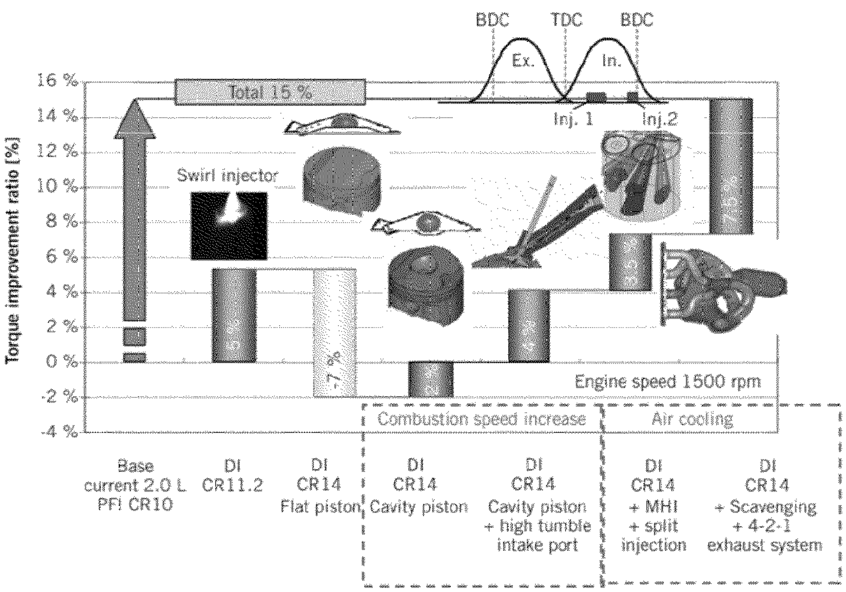


Figure 3: Several engine improvements in the Mazda SkyActiv-G lead to a net 15% increase in torque with lower fuel consumption. SOURCE: Mazda 2011, [8]

Mazda's new engines are designed around the specific combustion chamber of each engine, to ensure the most efficient combustion process. This maximizes efficiency and reduces the time it takes to calibrate each engine, but it eliminates interchangeable parts among different sized engines (a common industry practice). To rebalance this tradeoff, Mazda uses more functional robots to create their new engines. These machines are highly capable, and cut engine production time by 4.7 hours compared with fixed assembly lines, (from 6.0 to 1.3 hours) and decrease initial investment by 70%.[10]

While the Agencies considered Atkinson cycle engines in the rulemaking, the Mazda SkyActiv engine meets the Agencies' efficiency targets for naturally aspirated engines a full decade early and suggests that naturally aspirated engines may be able to compete with turbocharged engines in some vehicles well into the future.

Atkinson Cycle Engines

As described above, the Atkinson cycle is a simple way in which to improve fuel economy of a conventional engine at relatively little cost, using clever valve timing. By delaying intake valve closing, compression of the fuel-air mixture begins late. This method effectively separates compression ratio from the expansion ratio and allows the combustion gases to expand beyond the point at which compression began, extracting more work from the gases. Although the higher expansion ratio improves efficiency, the late intake closing allows an increase in the geometric compression ratio because it reduces the trapped mass of charge which also lowers the maximum torque and power of the engine. Thus, to retain vehicle performance, Atkinson cycle engines are generally increased displacement or are paired with full hybrid systems, where the electric propulsion motor adds significant torque and returns the system to an equivalent level of performance. All Ford and Toyota hybrid systems use Atkinson cycle engines, with a 2015 market penetration of 2.5%.

The Agencies did not explicitly estimate the cost of Atkinson cycle engines. The National Academy of Sciences published a recent report analyzing the costs and benefits of technologies available to manufacturers to meet 2017-2025 regulations.[12] Although many of the estimates in this report mirror the agencies', additional estimates were made for high compression ratio and Atkinson cycle engines. These are incorporated here as a reference for estimated costs in these two types of improved engines.

NAS 2015 [12] estimated that increasing the compression ratio, while maintaining the same regular octane fuel, would cost between $50-100. For high compression ratio engines that also use the Atkinson cycle (such as Mazda's SkyActiv and Toyota's ESTEC engines, see below), the NAS 2015 cost estimate is $250-500. Relative to a baseline vehicle with none of the following technologies, this cost includes increased compression ratio, a 4-2-1 scavenging exhaust manifold, direct injection, and redesigned piston crowns (VVT is also necessary, but is already present in the baseline). These technologies are found on Mazda's SkyActiv engine and Toyota's ESTEC engines (although The ESTEC engine does not have direct injection), discussed below.

At a minimum, Atkinson requires VVT, at least intake cam phasing (where the intake valve timing alone can be adjusted), whose costs the agencies estimated at $31-63 in 2025. VVT's market share supports that it is already quite cost effective, as evidenced by its near 100% market penetration. Atkinson cycle engines also have higher compression ratio, the cost of which was estimated by NAS 2015 to be $50-100 (for just the increased CR). Finally, the NAS estimate included the cost of direct injection, estimated by the Agencies at $164-$294. Thus, the cost of Atkinson cycling itself is likely to be low.

To improve power and performance while achieving high fuel efficiency, Toyota plans to improve its Atkinson cycle engines by increasing compression ratio (much in the same way Mazda utilizes valve control and high CR to reduce fuel consumption), coupled with in-cylinder modifications and enhanced valve and temperature control strategies. For the 2016 Prius, Toyota has increased peak thermal efficiency of the Atkinson cycle engine to over 40%, a significant improvement over the 38.5% peak thermal efficiency of its predecessor.[13]

The improved engine also reduces the performance loss, enabling Toyota to expand use of the Atkinson cycle engine to non-hybrid vehicles for the first time. Toyota will implement these improvements on 14 new engines starting with 2015, affecting 30% of Toyota's lineup, and boosting fuel efficiency by 10%[14].

To achieve the Atkinson cycle on conventional gasoline engines, Toyota expanded the range of their hydraulic VVT (VVT-iW, "intelligent-Wide range" variable valve timing). Conventional valve timing was used for performance and extreme valve timing was used for an Atkinson-like cycle for efficiency. Other technologies added to improve efficiency were cooled EGR, variable fuel injection pressure, and upper and lower water jackets for faster engine and catalyst warmup. Thermal efficiency was improved (BSFC, see Figure 4) by increasing the compression ratio to 13:1 and the low load, high efficiency region was expanded through use of the Atkinson cycle.[15]

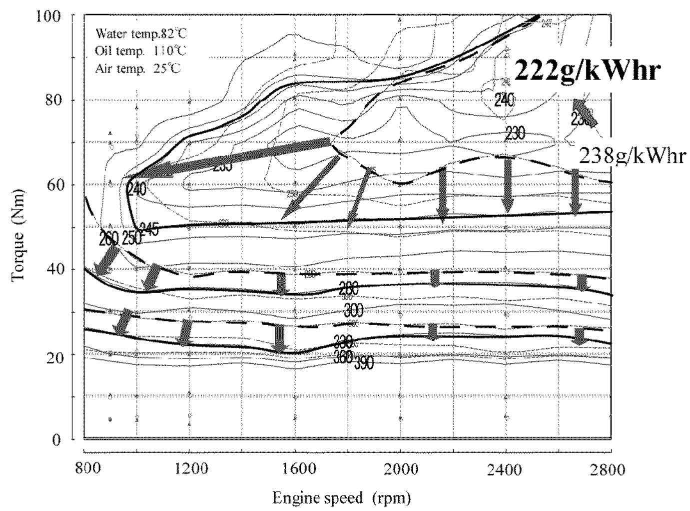


Figure 4: The use of Atkinson cycle in Toyota's redesigned higher compression ratio engines significantly broadens the regions with lowest BSFC. SOURCE: Yamada et al. 2014, [16]

Hyundai has also introduced a highly thermally efficient production engine for its Ioniq hybrid. The powertrain system includes a 1.6-liter Atkinson cycle engine with a peak thermal efficiency of 40%—essentially matching or exceeding the 2016 Prius hybrid engine efficiency.[17]

In its 2016 draft report[20], FEV found that implementing the Atkinson cycle would cost nothing on top of the cost of a VVT/VVL system (in that report, "Miller" cycle is used to refer to both Atkinson cycle on a naturally aspirated engine, and Miller cycle on turbocharged engines). The costs of a VVL system, in this report, were between $92-120 when installed on engines already equipped with VVT. The particular VVL system assessed by FEV was one very similar to VW's ACT system (see below) in structure and operation.

In general, fuel consumption of Atkinson cycle (late intake valve closing) engines is lower than that of Otto cycle engines. On BSFC engine maps, Atkinson cycle engines exhibit a wider area of low fuel consumption, with VVT, primarily, enabling the late intake valve closing characteristic of the Atkinson cycle. High geometric compression ratio offsets the otherwise lower effective CR of Atkinson.[18]

Estimates for the benefits of Atkinson cycle were determined, from suppliers, using information disclosed by Toyota ([19], [14] , [2]) as well as simulations for the Miller cycle conducted by FEV in their 2016 analysis (albeit on a downsized turbocharged engine), and from NAS 2015 (which drew from Mazda and Toyota sources). Toyota's non-hybrid Atkinsons are not simple substitutions of Atkinson cycle for Otto cycle (it includes a more complete technology package, see [15], [18]). Nevertheless, the greatly reduced fuel consumption under a wider range of engine loads is possible with Atkinson cycling. Overall fuel consumption reductions ranged from 3.1-10%.[17,18,Error! Bookmark not defined.]

Cooled EGR

Cooling the exhaust gas recirculation reduces combustion temperature, which reduces heat losses and also enables higher compression ratio and other combustion improvements. This is a key enabler for continued increases in naturally aspirated engine efficiency. Modeling of cooled EGR on turbocharged engines in FEV's 2016 draft report[20] yielded 2.5% efficiency improvements. This is lower than the agency's estimate of 5% improvement. The benefits of cooled EGR on naturally aspirated engines may be somewhat different.

FEV also conducted updated cost estimates for a cooled EGR system, of $113-$143 (compared to no EGR system). These are lower than the estimate in the 2017-25 rule of $180.

Stop/start, GDI, and cylinder deactivation cost estimates

Supplier cost estimates can be difficult to come by, as suppliers are reticent about revealing costs. Thus, FEV's 2016 forthcoming report [20] was used to estimate costs for stop/start, GDI, and cylinder deactivation technologies..

Stop-start costs were estimated by FEV to be $76-86. This includes the costs of a more robust starter/alternator, as well as more capable battery and various additional sensors.

FEV also analyzed the cost of replacing a PFI system with GDI. The hardware for such a system requires a high-pressure pump (which is driven by the engine) and high-pressure rail, as well as new injectors. The higher the pressure of the DI system, the higher costs. FEV found that such a system would cost $28-52 per cylinder. This is very close to the cost estimate for DI provided in the rulemaking: $37-55 per cylinder.

As described above,[20] FEV estimated the increased cost of VVL ranges from $95-123 (85-110€) depending on engine size and number of cylinders. This was based on VW's ACT system (2 stage cam profile switching), which uses two lobes—high and low—and an actuator to axially slide the cam along the camshaft.[23] VVL costs are compared to a baseline engine with discrete VVT already installed. Using one cam profile with zero lift (i.e. deactivated valve) and one with normal lift means the cost of cylinder deactivation using

VW's system is the same as a more general VVL system. With the structure of ACT, implementing a Miller or Atkinson cycle with DVVT and VVL is possible at no additional cost (VVT and VVL are both present). Costs would likely be minimal higher for valve lifts that go from high, to low, to zero lift (i.e. three cam profiles).

Thus, FEV's cost for cylinder deactivation is actually an estimate of the cost of 2-stage DVVL, which uses cam profile switching to switch between high and low profile cam lobes. Replacing the low lift profile with a zero-lift profile permits DEAC instead of DVVL.[23] Alternatively, simply adding a third, zero-lift cam profile maintains the VVL capabilities of the engine, but adds cylinder deactivation, at slightly increased costs. Note that the rulemaking estimated the 2025 cost of discrete VVL ("DVVL") at $24-26 per cylinder, which is between $5-10 less than the DVVL cost estimated by FEV. The agencies estimated DEAC costs to be $33-39 per cylinder, but this only accounts for finger-follower de-lashing on a fixed block of cylinders (half the cylinders of a V6 or V8).

Both the rulemaking and FEV cost estimates for cylinder deactivation apply to conventional DEAC strategies: only a fixed group of cylinders can deactivate. As described below, newer, more advanced strategies permit variable numbers of cylinders to deactivate. This requires equipping all participating cylinders with the necessary hardware for deactivation (additional actuators, e.g.). As such, costs per cylinder will be higher.

Improvements in Development

Cylinder Deactivation

Conventional cylinder deactivation normally applies only to larger engines with an even number of cylinders. This allows cylinders to deactivate symmetrically in order to avoid intense torque fluctuations and vibration. The analyses in the 2017-25 rule were limited to this type of cylinder deactivation.

There is a major area of improvement in cylinder deactivation: dynamic deactivation of individual cylinders. There are many systems currently in development. These systems continually change the active cylinders and have many potential advantages over conventional cylinder deactivation:

- Maintains uniform engine operation temperatures.
- Allows the throttle to remain nearly fully open by controlling engine power by varying the firing cylinders.
- Handles noise, vibration, and harshness by dynamically controlling which cylinders fire, which allows use of cylinder deactivation at lower engine rpm, (Figure 5, upper).
- Expands the range of applicability to smaller engines and those with odd numbers of cylinders; typically 3 cylinders (Figure 5,, lower).
- Capable of switching between 4-stroke and 2-stroke operation, potentially enabling engine downsizing without the need for boost.

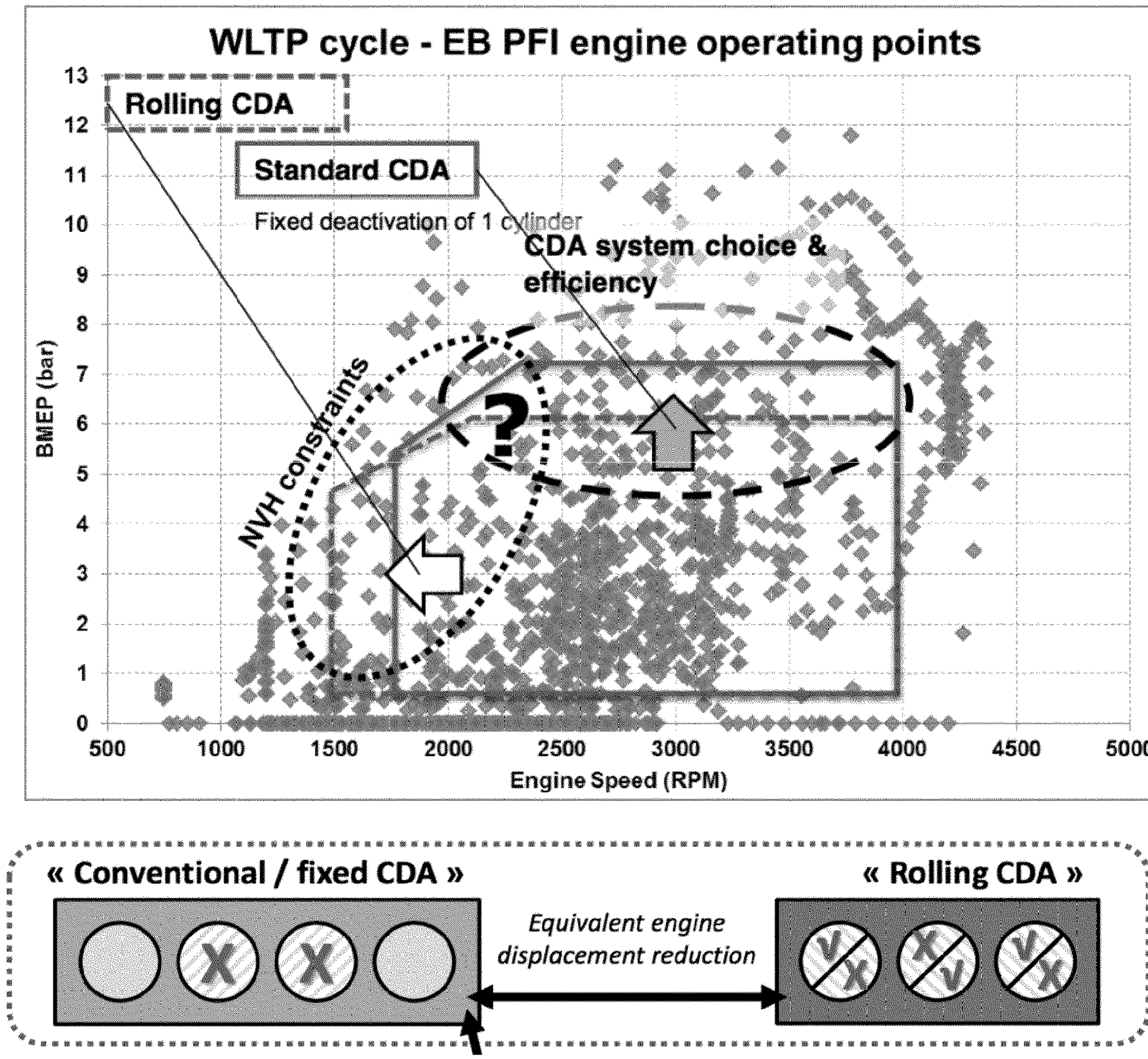


Figure 5: Eaton and PSA, Dynamic Cylinder De-Activation: System approach and performance potential, 07/10/2015

Tula's Dynamic Skip Fire (DSF, utilized by GM) is a fast-acting cylinder deactivation strategy expected to launch within five years (as of 2015).[24] A V8 could cruise on the highway with as few as two cylinders firing. After optimizing the transmission calibration and accounting for noise and vibration features, the study found a 14% increase in MPG over the combined FTP/highway cycles. Note that the V8 engine used in this study did not have variable valve timing, so the benefits would be far lower on an engine with more advanced valve timing, but this is still about twice the 6.5% improvement estimated by the Agencies for a comparable engine with fixed valve timing. Cost to install would be $300-600 ($38-75 per cylinder for a V8), due to installation of hardware on all cylinders (as opposed to just four for convention deactivation on a V8).[21,21] This includes the full cost of all variable valve train components, as the baseline engine had fixed valve timing.

DSF, like all DEAC systems, seeks to keep the combustion process in the engine at a point of peak efficiency. At part/reduced load, DSF reduces throttling by using only a portion of the cylinders for combustion. Thus, these active cylinders may operate at high load, where they are most efficient, and dynamically controlling which cylinders fire handles noise, vibration, and harshness (NVH) systematically.[22]

VW implemented Active Cylinder Management Technology (ACT) on the Polo (EU) and has plans for the Passat (US) and Golf.[23] The system deactivates cylinders 2 and 3 (inline-4), and can operate over 1400-4000 rpm at 25-100Nm.[24] ACT uses a slightly modified camshaft. It is fitted with sleeves/bushings ("cam pieces") that permit cam profile switching, and simple actuators to engage the cam pieces. Thus, ACT enables discrete/dual VVL (i.e. valve open or closed). To implement this technology (discrete/dual VVL), the engine requires a new camshaft, one actuator per cylinder, and some cylinder head modifications to mount the actuators. Thus, total costs generally depend on the number of cylinders on an engine. The Polo saw fuel consumption reduced by 0.4l/100km, from 5.0l/100km to to 4.6l/100km, on the NEDC, or about 8%..The report did not say if the baseline engine had variable valve timing or not and the efficiency gains on the US cycles might be somewhat less than on the NEDC.

Eaton, partnering with PSA (Peugeot), developed its Dynamic-Cylinder Deactivation system (D-CDA, or "rolling cylinder deactivation")[25]. It enables engines with odd numbers of cylinders to reap the benefits of cylinder deactivation. Conventionally, deactivation with odd numbers of cylinders leads to irregular torque output and engine vibration. Eaton solves this problem by deactivating each cylinder every second cycle, effectively converting a 3cyl into a 1.5cyl (e.g. 1.5L into a 0.75L).[26] According to PSA simulations, their improved dynamic or rolling CDA reduces fuel consumption by at least 1.5% compared to fixed cylinder deactivation. Furthermore, Eaton's D-CDA can be applied to cold start because it is less sensitive to oil temperature than conventional hydraulic actuated systems[Error! Bookmark not defined.]. Overall, PSA estimates a fuel consumption benefit of 3.5-4.0% on the WTLP cycle for EB port fuel-injected engines (engines specific to PSA). Eaton expects further developments in the form of 2- and 3-way axial cam shifting to enable Miller cycling, improved VVL, and 2/4-stroke operation[27].

In 2013, Honda brought together their 3-stage variable valve timing and lift electronic control (VTEC) system, with their Variable Cylinder Management system on a DI 3.5L V6 (Acura RLX). Vibration of the (deactivated) 3-cyl engine was controlled with an active engine mount, resulting in an increased range over which cylinder deactivation operated. Later versions of the system used in the Honda Odyssey were able to switch from 6-cyl to 4-cyl to 3-cyl, depending on the load. Essentially, the VTEC system permits high, low and no valve lift, while the VCM system manages when and which cylinders undergo zero lift. To achieve this, Honda consolidated cam lobes and maintained compact cam width, thereby improving and simplifying manufacturing.

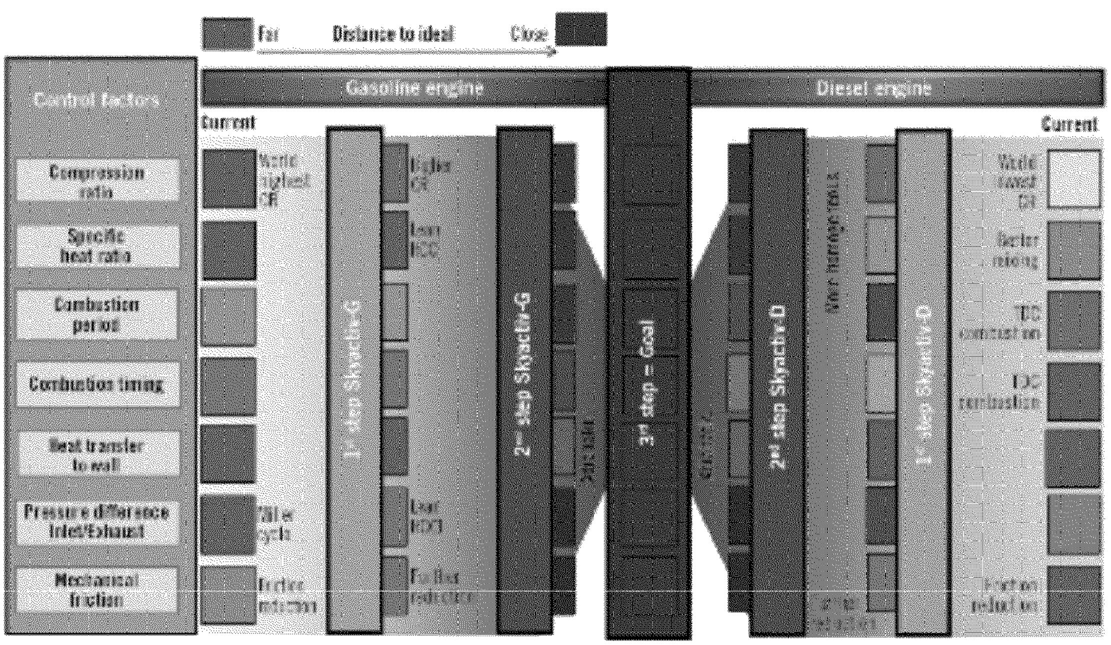
Overall, it is difficult to estimate the benefit of dynamic cylinder deactivation, as it is highly dependent on the sophistication of the variable valve system on the comparable vehicle. Most of the benefits of cylinder deactivation are reductions in pumping losses, which are also reduced by a variety of other technologies. Still, dynamic cylinder deactivation can reduce pumping losses even further and it also reduces heat transfer due to the higher BMEP in the cylinder. Benefits versus fixed cylinder deactivation are likely to be in the range of 1.5% to 4%, as estimated by Eaton/PSA.

High compression and Atkinson cycle engines

Mazda's second-generation SKYACTIV-G petrol engines could emerge by 2018 with compression ratios between 16:1 and 18.0:1.[28] This engine would use homogeneous charge compression ignition (HCCI) as the next step. HCCI works by using the heat and pressure inside the cylinders to ignite the air/fuel mixture without requiring a spark plug for ignition. It has been the subject of research and development since the seventies with production applications generally stymied by control issues. The advantage that has motivated the research is the promise of unthrottled highly dilute operation at light load.

Mazda is already working on third-generation SKYACTIV technology, which will include adiabatic combustion chamber technology, reduced combustion duration, and lean HCCI.[29] If successful, this could lead to another reduction in fuel consumption by improving low-speed efficiency and reducing exhaust energy and cooling losses.

Because the benefits and production potential of HCCI and adiabatic technology are still speculative, these have not been included in the technology summaries in this report. Still, it is interesting to note that further improvements are being actively pursued.



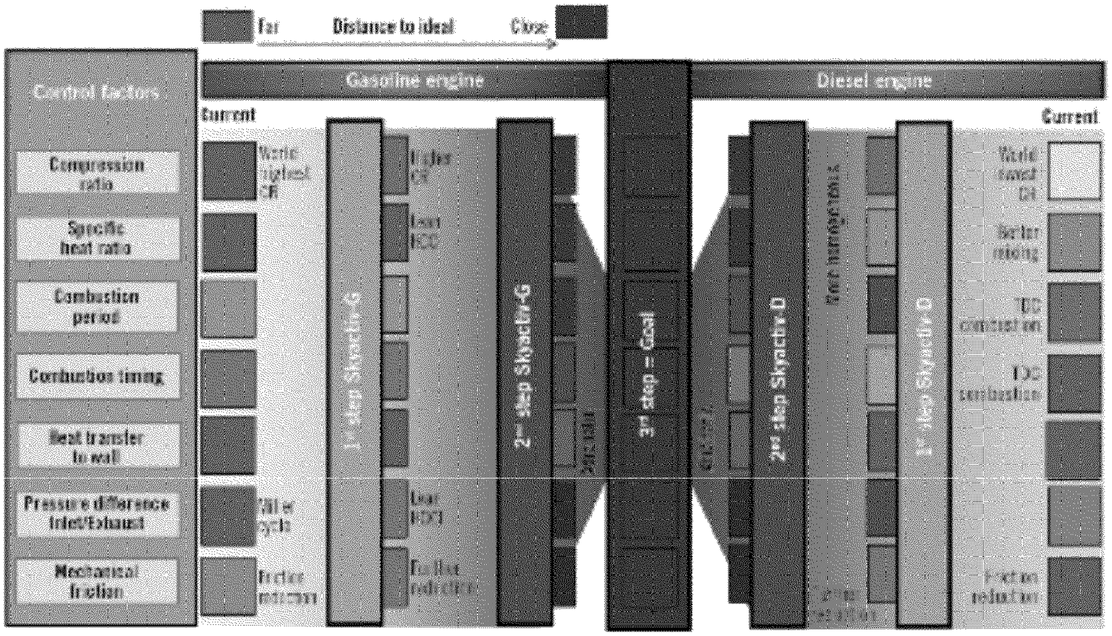


Figure 6: Mazda map for incremental improvements in gasoline (and diesel) engines. SOURCE: Hirose et al. 2016, [31]

Subaru has set the goal of developing engines with thermal efficiency >40% by 2020.[30] Subaru will improve its engines' efficiency by adding cylinder deactivation and lean combustion by 2020, and likely Atkinson cycle (although lean burn may prove difficult given the stringent NOx standards in the US, and the higher NOx output of lean burn). This level of engine efficiency would be higher than the engine currently available in the Prius Hybrid.

Improved Stop-Start Systems

Stop start was estimated by the agencies to have 1.8-2.4% benefit. Improved stop-start systems are in development that also turn the engine off while the vehicle is decelerating (sometimes referred to as sailing), not just when it stops. According to the draft FEV analysis, between 2.3-4.3% reduction in fuel consumption is possible with such an advanced stop-start system. Also, the vast majority of these benefits are during urban driving, during which stop-start greatly reduces idling time. Furthermore, NAS 2015 estimates that the benefits of conventional stop-start in real world driving may be higher than on test cycles (up to 5% instead of 2.1%), which manufacturers can capture by applying for off-cycle credits.

Due to the more advanced stop-start system considered by FEV, costs may not be directly comparable. However, FEV estimated that their stop-start system would cost $76-86: significantly cheaper than the agencies' estimated $225-279. This may be partially due to the fact that the FEV stop-start system does not have all the regenerative braking capability as that considered in the rulemaking. (FEV considers regenerative braking in their P0 hybrid, which uses 48v.)

Consumer Acceptance Issues

Variable valve timing and lift provide improved vehicle performance, in addition to the efficiency benefits. Thus, there are no consumer acceptance issues for these technologies.

Cylinder deactivation can lead to increased vibration and noise from the engine. Manufacturers have successfully addressed these issues by improving motor mounts and adding noise cancelling systems. Dynamic deactivation of individual cylinders will further reduce noise and vibration from the engine.

Atkinson cycle engines have historically not been used on conventional vehicles due to the loss in power. However, recent improvements have mitigated the power loss and Toyota is in the process of introducing its Atkinson cycle engine on many conventional vehicles in its lineup. Mazda has also successfully introduced its SkyActiv engine in most of its vehicles without consumer complaints.

The primary consumer acceptance issue has been with stop/start systems. Some systems have noticeable noise and vibration when the engine restarts and customers can think their engine has stalled when it shuts off at a light or stop sign.[31] Still, it is expected that customers will get used to the system with experience and there is a button to turn it off if the driver wants to. The noise and vibration issues should also diminish as manufacturers gain experience with the systems and develop improved hardware and control algorithms.

Discussion: Comparison of current production costs, new developments, and agency projections

Many of the innovations driving efficiency gains in naturally aspirated engines build on top of a technology that is now nearly universal in the vehicle fleet: Variable valve timing (VVT), and its close cousin, variable valve lift (VVL).

The most recent developments use VVT to facilitate the use of more efficient combustion cycles, such as the Atkinson cycle engines used by Toyota. But VVT and VVL are the cornerstones of a host of new engine innovations that are driving gains in fuel economy for all types of engines, including those that are naturally aspirated. Additional innovations enabled by VVT and VVL include cylinder deactivation, and Atkinson-like engine performance.

Due to the suite of additional fuel efficiency gains made possible by VVT and VVL, some of the vehicles with naturally aspirated engines on the market today, such as Mazda's SkyActiv series, already meet the 2020 model year CAFE standards - four years ahead of schedule.

The following figures on technology penetration and fuel consumption reductions and the table on costs summarize the discussion, above, comparing the most recent estimates with the rulemaking projections. The left half of Figure 7, below, shows the market penetration of select technologies discussed in this brief, from 2004 to 2015 (Fuel economy trends report [1], note that the 2015 values are estimates). The right half (dotted lines) shows the market penetration growth trends and a comparison of these trends with predictions made by the EPA/NHTSA for the 2017-2025 RM. This is followed by a Table 5 of technology cost estimates and a figure comparing incremental fuel consumption reductions.

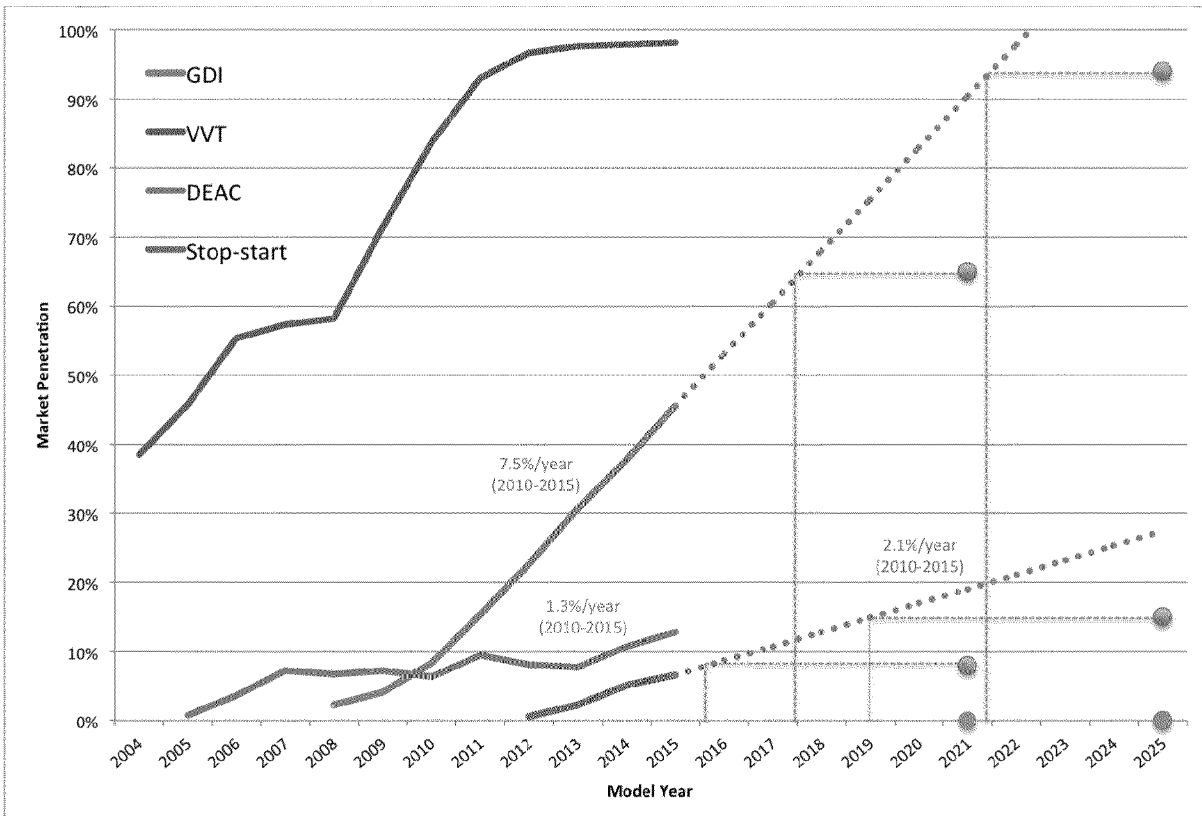


Figure 7: Market penetration of select technologies, and extrapolation to rulemaking (RM) projected penetration

Table 5: comparison of estimated costs in rulemaking and suppliers

Green means "on track"	Supplier estimated cost in 2025	Rulemaking estimated cost in 2025
Stop-Start	$76-86	$225-279
GDI ($/cyl)	$28-52	$37-55
DEAC ($/cyl)**	$35-36	$33-39
Cooled EGR	$113-145	$180

Atkinson cycle		$200-400*-
$High CR		$50-100*-

GDI: gasoline direct injection; DEAC: cylinder deactivation; CR: compression ratio
*From NAS 2015. Their Atkinson cycle costs include 4-2-1 scavenging exhaust manifold, GDI, and redesigned piston crowns, none of which are required for Atkinson cycle engines.
** Conventional cylinder deactivation

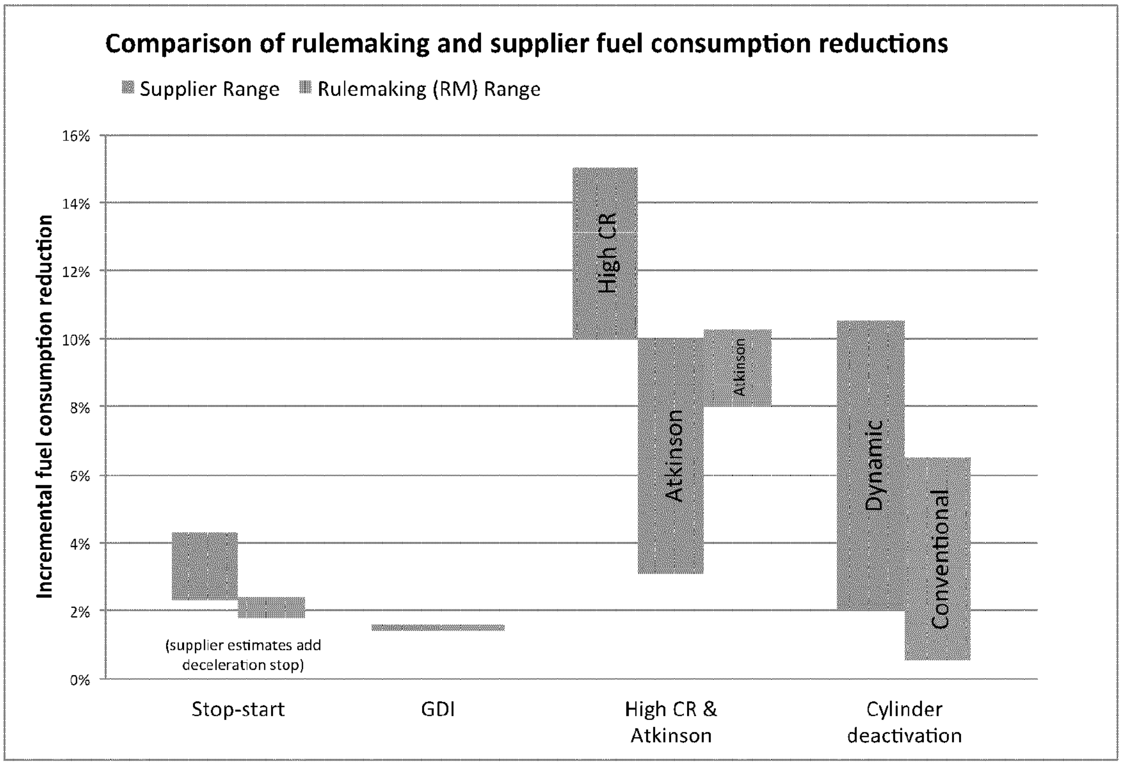


Figure 8: comparison between rulemaking (purple) and supplier (red, FEV et al.) estimated incremental fuel consumption reductions

As clearly shown in the technology penetration figure (Figure 7), **VVT is nearly ubiquitous** in the fleet. This indicates that improvements enabled by VVT, such as emissions control (faster catalyst light-off and engine warm-up, e.g.) and fuel efficiency (Otto cycle for high torque, Atkinson for high efficiency, e.g.) no longer require manufacturers to invest in additional expensive hardware. It also means that many of the benefits from these technologies are already incorporated into today's products.

GDI market share increased approximately linearly at a rate of 7.5 percentage points per year from 2010 to 2015. As indicated by the dotted blue line, if this trend continues GDI will reach 65% market penetration sometime between 2017-2018, and 94% penetration between 2021-2022. As shown, the agencies predicted 65% and 94% market penetration by 2021 and 2025, respectively. Thus, the current rate of market penetration puts **GDI 3-4 years ahead of schedule**. An updated assessment of GDI cost by FEV and fuel consumption reduction by NAS 2015 are both similar to the projections in the 2017-25 rulemaking.

The agencies predicted 8% market penetration in **stop-start** systems by 2021 and 15% by 2025. However, since 2012, the market share of stop-start has grown steadily at 2.1 percentage points each year. This means that **stop-start is 5-6 years ahead of schedule**, assuming the rate of growth continues (purple line in Figure 7). Stop-start is not only ahead of schedule in market penetration, but also is estimated to be more efficient, due to increased capabilities such as stopping the engine during deceleration, and to cost significantly less than estimated by the agencies (FEV report, [19]).

Cylinder deactivation, shown in green in Figure 7, was not expected to play any significant role in the 2021 and 2025 fleets. Since 2010, it has seen approximately 1.3% market share growth each year, and is currently at 12.8% (est.). Some implementations of cylinder deactivation (VW, e.g.) are simply VVL with zero-lift cam profiles (essentially deactivating the cylinder by not lifting valves). Thus, the increased market share of cylinder deactivation may be a sign that OEMs and suppliers are prepared for other and additional (discrete) VVL systems. An updated assessment of conventional cylinder deactivation cost by FEV is similar, if slightly lower than, the projections in the 2017-25 rulemaking. Importantly, the Agencies assumed that a fixed group of cylinders would deactivate (for example, a V6 would have 3 inactive cylinders, the V8 four). However, improvements in cylinder deactivation control ("Dynamic Skip Fire" by Tula/GM, and "rolling" or "dynamic cylinder deactivation" by EATON/Peugeot) permit engines with as few as three cylinders to take advantage of deactivation benefits, with lower NVH and additional deactivation at lower engine speeds. As a result, all cylinders may be equipped with the necessary hardware, implying costs scale with the number of cylinders. Supplier estimates of fuel consumption reduction with active cylinder deactivation range from 2% to 10.5%, significantly higher than the estimates for conventional cylinder deactivation in the 2017-25 rulemaking of 0.5% to 6.5%.

The share of **Atkinson cycle** engines is currently limited primarily to hybrid vehicles and the Agencies projected that this would also be true through 2025, with Atkinson cycle engines only used on strong hybrids (4% market share in 2021 and 5% in 2025). However, Toyota has announced that they have reduced the trade-off between Atkinson-cycle efficiency and reduced torque, thereby expanding the application of the Atkinson cycle to non-hybrid vehicles. Toyota refers to these improved engines as "ESTEC" engines.[18] Hyundai and Subaru are also introducing improved, higher efficiency Atkinson cycle engines. In addition, Mazda's SkyActiv engine has a number of technologies enabling a **high compression ratio**, which was not separately considered in the Agencies' projections (Atkinson cycle engines also have high compression ratio). While naturally aspirated engines may still be replaced by downsized turbocharged engines in the future, it is clear that some manufacturers have a lot of interest in Atkinson cycle and other high compression ratio concepts and these engines will be much tougher competitors than projected by the Agencies.

As the rulemaking did not anticipate Atkinson cycle engines in non-hybrids, the Agencies did not estimate those costs. But Atkinson requires VVT, at a minimum intake cam phasing (where the intake valve timing alone can be adjusted), whose costs the agencies estimated at $31-63 in 2025. VVT's market share supports that it is already quite cost effective, as evidenced by its near 100% market penetration. Atkinson cycle engines also have higher compression ratio, the cost of which was estimated by NAS 2015 to be $50-100.[12] Thus, the cost of Atkinson cycling is unlikely to be more than $100 (and FEV estimated zero cost).

Atkinson cycle engines were projected by the Agencies to reduce fuel consumption by 8.0 to 10.3%. It appears that manufacturers are on track to match or exceed these improvements. Mazda's current production SkyActiv engine already matches or exceeds the Agencies' efficiency estimates for Atkinson cycle engines in 2025. And this does not include technologies currently in development, such as cooled EGR, Miller-cycle engines, HCCI, and adiabatic engines. These technologies are more speculative and, thus, have not been included in the summaries in this report, but they still illustrate that additional improvements are highly likely.

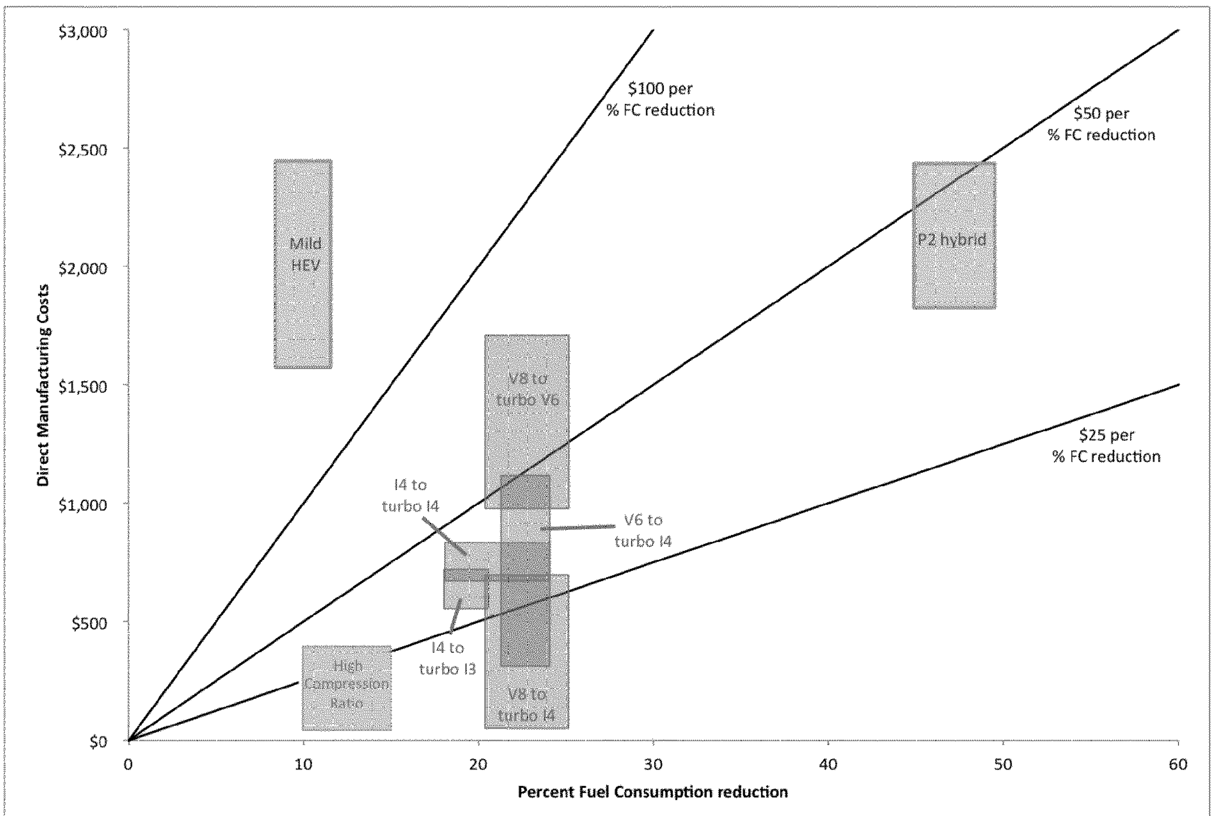


Figure 9: Comparison of overall costs for high compression ratio engines (like Mazda SkyActiv) and turbocharged & downsized (TRB-DS) and hybrid (HEV) as estimated by NAS 2015 and EPA/NHTSA.

Figure 9 compares the estimated 2025 fuel consumption reduction and direct manufacturing costs for high-compression ratio naturally aspirated engines (blue box) with downsized & turbocharged engines (red boxes) and hybrids (orange boxes). Boxes indicate the estimated range of costs per percent fuel consumption reduction. The hybrid and turbocharged data were taken from the 2017-2025 rulemaking and NAS 2015.[12]

The figure shows that the fuel-efficiency gains from high-compression engines (measured in terms of percentage reduction in fuel consumption) are not as great as those possible from hybrids and downsized-turbocharged engines. But the increase in manufacturing costs for high-compression engines are significantly lower, $50 to $500 (cost estimates vary widely), so the cost-benefit ratio is quite good. And this does not include possible future improvements in efficiency from even higher compression ratios, cooled EGR, further valve timing improvements, dynamic cylinder deactivation, and improved stop/start systems.

Figure 9 also shows that turbocharging and downsizing is most cost-effective when the number of cylinders can be reduced: in particular V8 or V6 to I4, and for some I4 to I3.Error! Bookmark not defined. Naturally aspirated engines cannot compete with the substantial cost savings in replacing the two cylinder heads of a V-configuration engine with an inline 4-cylinder turbocharged engine, but the cost benefits of engine downsizing are greatly reduced when starting with an inline engine. As of 2014 just over half of all light duty vehicles (56%) had 4 cylinders, with a similar portion of the market estimated for 2015[1] While some manufacturers are committed to downsizing all, or most, of their lineup, these improved naturally-aspirated engines provide an opportunity for more cost-effective solutions on perhaps up to 25% of the fleet.

Table 6: Naturally aspirated engine technology compared to EPA/NHTSA 2017-2025 rulemaking (RM)

Ahead of RM On Schedule Behind RM	Stop-start	Gasoline Direct Injection	High Compression ratio	Cylinder Deactivation	Atkinson Cycle
Cost			n/a		n/a
Penetration					
Benefits					

Table 6 summarizes the latest assessment of future technology penetration, cost, and fuel consumption reductions compared to the technology assessments in the 2017-25 rulemaking. The main naturally aspirated technologies are all on track or ahead of the rulemaking assessments in every way. The fuel economy of naturally aspirated vehicles is improving more rapidly than was projected by the agencies in the 2017-25 rulemaking. The continuous cycle of vehicle innovation is driving these improvements - such as the extremely high compression ratio in Mazda's SkyActiv engine; the individual cylinder deactivation in GM's Dynamic Skip Fire engine; and Toyota's introduction of an improved, Atkinson-cycle engine on non-hybrid vehicles.

Based on the success of Mazda and Toyota, it is clear that the goal of good performance and fuel economy can be reached with highly flexible valvetrains that permit increasing compression ratio. The resulting engines are capable of both Atkinson and Otto cycles, which broadens the range of efficient operation at a cost manageable by at least two major automakers.

As with the Atkinson cycle and knock-risk reduction of high compression ratio engines, cylinder deactivation is enabled by variable valve timing and lift control. VVT/L systems that already exist for Atkinson cycle and high compression ratio engines would require only minor modifications to enable a zero lift cam profile, or lashed finger-followers, i.e. cylinder deactivation. The resulting engine may be capable of cylinder deactivation, Atkinson cycle, and have high compression ratio. Specific engine loading would determine which strategy best optimizes fuel consumption.

Continued improvements to naturally aspirated engines suggest that there may be a larger role for these engines than previously estimated as manufacturers struggle to meet aggressive fuel economy and CO_2 standards

Appendix

[final graphic: Line graph showing trend line extensions back to 1990 CAA amendments OR 2003 NAS/NHTSA study; project forward to 2017 mid-term review; extend through 2021 model year; top 5 techs; cost per vehicle, fuel savings]

	2015 pen. (est.), FE trends	**2021 pen., RM**	**2025 pen., RM**	**Est. cost, RM**	**Est. cost, suppl.**	**Fuel cons. Benefit, RM**	**Fuel cons. benefit, supplier**	**Status & explana-tion**
GDI	45.6%	65%	94%	$164-296	$70-120	1.5%		On schedule
VVL				$99-296		2.8-4.9%		
DVVL		12-52%	11-52%	$99-204	$92-120	4.1-4.9%	0.7-1.1%	On schedule
CVVL		16%	16%	$148-296		3.6-4.9%		
DEAC	12.8%	1-9%	1-5%	$118-133	$300-600 $95-123	0-6.5%	<21% 9% 3.5-4.0%	On schedule
Stop-start	6.6%	8%	15%		$76-86	1%	0.1-5.5gCO2/km	Ahead of schedule
Adv. Stop start					$(13)-6	1.8-2.2%	1.9-3.9%	See above

Atkinson/Miller					$0	9-10.2%	15% 10% 3.6-4.6%	Ahead of schedule

RM: rulemaking
GDI: gasoline direct injection
VVL: variable valve lift
DVVL: discrete variable valve lift
CVVL: continuous variable valve lift
DEAC: cylinder deactivation
Stop-start: starter modified to handle multiple starts, system enhanced for same purpose
Advanced stop-start: can shut engine down at higher velocity than stop-start
Atkinson/Miller: in FEV's analysis, Miller cycle defined as intake valve left open longer than normal (which matches what others describe as "Atkinson"), at no cost when DVVL is already installed (on a VVT-equipped engine)

[1] Engine Heat Transfer Engine Heat Transfer - MIT, slide 19.
http://web.mit.edu/2.61/www/Lecture%20notes/Lec.%2018%20Heat%20transf.pdf

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14 new Toyota engines seek 10% gain in mpg. Auto News p 8. April 14, 2014

[4] Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards. http://www.nap.edu/catalog/10172/effectiveness-and-impact-of-corporate-average-fuel-economy-cafe-standards

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http://www.mazda.com/en/innovation/technology/skyactiv/skyactiv-g/

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14 new Toyota engines seek 10% gain in mpg. Auto News p 8. April 14, 2014

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Hyundai: Ioniq highway mpg to top Prius. Jan 4. 2016

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[23] http://media.vw.com/release/601/

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Mazda pins improved mpg on Skyactiv 2, Automotive News, January 6, 2014.
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http://www.detroitnews.com/story/business/autos/2014/10/07/autos-stop-start-driver-resistance/16893597/

To: Moran, Robin[moran.robin@epa.gov]
From: Dave Cooke
Sent: Mon 2/29/2016 7:29:51 PM
Subject: RE: UCS Whitepaper: Fuel Economy / Performance trade-off

Glad to be of help. I'm certainly looking forward to meeting tomorrow—glad to reconnect with you and the rest of the agency folks. See you then,

- Dave

From: Moran, Robin [mailto:moran.robin@epa.gov]
Sent: Sunday, February 28, 2016 12:36 PM
To: Dave Cooke
Subject: RE: UCS Whitepaper: Fuel Economy / Performance trade-off

Hi Dave,

Thanks so much, this will be incredibly useful.

Looking forward to seeing you at the workshop Tuesday.

Robin

From: Dave Cooke [mailto:DCooke@ucsusa.org]
Sent: Friday, February 26, 2016 11:29 AM
To: Alson, Jeff <alson.jeff@epa.gov>; Moran, Robin <moran.robin@epa.gov>; Helfand, Gloria <helfand.gloria@epa.gov>; Nam, Ed <nam.ed@epa.gov>; Bolon, Kevin <Bolon.Kevin@epa.gov>; Olechiw, Michael <olechiw.michael@epa.gov>; Moskalik, Andrew <Moskalik.Andrew@epa.gov>
Cc: Charmley, William <charmley.william@epa.gov>
Subject: UCS Whitepaper: Fuel Economy / Performance trade-off

EPA LDV team,

Attached is a whitepaper that looks at manufacturers' trade-off between applying technology improvements in light-duty vehicles towards either improved performance/acceleration or reducing fuel consumption. We at the Union of Concerned Scientists know that this is an issue that may play a critical role in the efficacy of light-duty efficiency regulations, and we've targeted this analysis specifically towards the effect the continued performance trend could have on the mid-term evaluation.

As author of the paper, I'm happy to discuss any relevant details of our modeling and answer any questions that you may have. We will obviously also formally submit this through the Draft TAR public comment, but I wanted to make sure that the agencies had time to consider our findings as you look at this critical climate regulation. We are also sharing it with colleagues at the other agencies involved in the mid-term evaluation (NHTSA, CARB), but feel free to pass it on to any relevant parties. Thanks,

- Dave

David W. Cooke, Ph.D.

Senior Vehicles Analyst

Union of Concerned Scientists

1825 K Street, NW 8th floor

Washington, DC 20006

p: 202-331-6948

f: 202-223-6162

e: dcooke@ucsusa.org

To: Moran, Robin[moran.robin@epa.gov]
From: John German
Sent: Tue 9/15/2015 1:38:19 PM
Subject: Re: ICCT Technology Briefs

Thanks, Robin. I will arrange my schedule to attend in person.

John

On Sep 15, 2015, at 8:30 AM, "Moran, Robin" <moran.robin@epa.gov> wrote:

> Hi John, I think it would be nice to have you here in person if that's possible, always easier for frank discussions. We can always move the date to something that works better for you too, if that's easier. Just let me know what's best for you.
>
> On the real-world gap issue, that's fine to add to the agenda. I may pull in Jeff Alson who's been our lead for this on the team.
>
> Robin
>
> -----Original Message-----
> From: John German [mailto:john@theicct.org]
> Sent: Monday, September 14, 2015 4:21 PM
> To: Moran, Robin
> Subject: Re: ICCT Technology Briefs
>
> Robin,
>
> How important is it for me to attend the meeting in person, instead of by phone? Ex. 6 - Personal Privacy Ex. 6 - Personal Privacy if it would add value to be at the meeting with Charmley in person.
>
> I also have a 3rd agenda item, which is the rapidly growing gap between fuel economy test results and in-use fuel consumption as reported on fueleconomy.gov. Our European office wants to include this in an upcoming report on the gap in 5 regions/countries and Nic expressed a concern about publishing this before the midterm review. I wanted to get an early reaction from Charmley about this.
>
> John
>
> On Sep 8, 2015, at 9:27 PM, "Moran, Robin" <moran.robin@epa.gov> wrote:
>
>> John,
>>
>> I didn't realize that Bill had already scheduled something with you for 1-1:30pm on Sept 24 (?) on the mass reduction topic. If that's still good for you, can you extend it from 1-2pm to cover the tech briefing papers too? You can come on over to our office.
>>
>> Thanks,
>> Robin
>>
>> -----Original Message-----
>> From: John German [mailto:john@theicct.org]
>> Sent: Friday, August 28, 2015 8:22 PM
>> To: Moran, Robin
>> Cc: Olechiw, Michael
>> Subject: Re: ICCT Technology Briefs

>>
>> Robin,
>>
>> I'm pretty open the weeks of September 14 and 21. A few one to two hour conflicts each week, but nothing much. Thus, I'm sure it would be better if you started with Bill's calendar.
>>
>> Ex. 6 - Personal Privacy
>>
>> Sent from my iPhone
>>
>>> On Aug 27, 2015, at 1:06 PM, Moran, Robin <moran.robin@epa.gov> wrote:
>>>
>>> John,
>>>

Ex. 6 - Personal Privacy

>>>
>>> We'd like to have you come over the EPA office sometime in later September to talk more about the briefing papers. As we told Nic when he first mentioned it, this is a great idea, and will be valuable sources we can reference in the draft TAR. I'm especially interested in your plans for rolling out (press interest, blogging, sharing with stakeholders - like NHTSA, etc), and what response you're getting back from suppliers.
>>>
>>> If you let me know a couple days that are good for you, I'll work with Bill's calendar. I know he had some ideas on the NAS mass reduction that he wanted to share too (which he hasn't even shared with us yet, so we'll be interested to hear what he has to say).
>>>
>>> Take care,
>>> Robin
>>>
>>>
>>> Robin Moran
>>> Senior Policy Advisor
>>> U.S. EPA, Office of Transportation and Air Quality
>>> 2000 Traverwood Dr.
>>> Ann Arbor, MI 48105
>>> (734) 214-4781 (phone)
>>> (734) 214-4821 (fax)
>>>
>>>
>>> -----Original Message-----
>>> From: John German [mailto:john@theicct.org]
>>> Sent: Thursday, August 20, 2015 4:20 PM
>>> To: Charmley, William
>>> Cc: Moran, Robin
>>> Subject: ICCT Technology Briefs
>>>
>>> Bill,
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>>> I think you know about the Technology Briefs that ICCT is doing, but I thought you might be interested in the latest developments.
>>>
>>> The goal of the briefs is to explore and document technology development since the analyses in the 2017-25 rulemaking and compare this to the projections in the rulemaking. Each technology brief is designed to stand alone and to feed into the mid-term review. The secondary goal is to involve suppliers, both to help craft the briefs and to provide more credibility.

>>>
>>> Attached are two documents. The Word document is an outline of our proposed technology briefs, which I have sent out to about 20 different suppliers and organizations. The first page provides an overview of the project, followed by outlines for technology briefs on downsized, boosted gasoline engines, naturally aspirated engines, transmissions, lightweighting, and diesels. Each outline includes a suggested list of possible participants, mostly suppliers (although I doubt I will be able to contact every organization on the lists, much less enlist participation).
>>>
>>> Also attached is the first technology brief, on hybrid vehicles. ICCT did this brief ourselves, in part to give suppliers an idea of what the technology briefs might look like and in part because we thought it would be more difficult to involve suppliers in the assessment, due to the complexity of the systems. Although, we certainly hope that the next technology briefs can be shorter.
>>>
>>> I would be happy to discuss this further with you. Let me know if you have questions.
>>>
>>> John
>>> 734-355-155
>>>
>

To: Moran, Robin[moran.robin@epa.gov]
From: John German
Sent: Mon 9/14/2015 8:21:07 PM
Subject: Re: ICCT Technology Briefs

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To: Moran, Robin[moran.robin@epa.gov]
From: John German
Sent: Fri 9/11/2015 4:25:48 PM
Subject: Re: ICCT Technology Briefs

Yes, this would be fine. There is a chance I will be in DC that week and we will have to do this by phone, but otherwise I will plan on coming to EPA.

John

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Cc: Olechiw, Michael[olechiw.michael@epa.gov]
To: Moran, Robin[moran.robin@epa.gov]
From: John German
Sent: Sat 8/29/2015 12:22:05 AM
Subject: Re: ICCT Technology Briefs

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>
> John
> 734-355-155
>

Cc: Moran, Robin[moran.robin@epa.gov]
To: Charmley, William[charmley.william@epa.gov]
From: John German
Sent: Thur 8/20/2015 8:19:33 PM
Subject: ICCT Technology Briefs
Technology Briefing papers - outline v3-clean.docx
ATT00001.txt
Hybrid Tech Briefing 01 v5.pdf
ATT00002.txt

Bill,

I think you know about the Technology Briefs that ICCT is doing, but I thought you might be interested in the latest developments.

The goal of the briefs is to explore and document technology development since the analyses in the 2017-25 rulemaking and compare this to the projections in the rulemaking. Each technology brief is designed to stand alone and to feed into the mid-term review. The secondary goal is to involve suppliers, both to help craft the briefs and to provide more credibility.

Attached are two documents. The Word document is an outline of our proposed technology briefs, which I have sent out to about 20 different suppliers and organizations. The first page provides an overview of the project, followed by outlines for technology briefs on downsized, boosted gasoline engines, naturally aspirated engines, transmissions, lightweighting, and diesels. Each outline includes a suggested list of possible participants, mostly suppliers (although I doubt I will be able to contact every organization on the lists, much less enlist participation).

Also attached is the first technology brief, on hybrid vehicles. ICCT did this brief ourselves, in part to give suppliers an idea of what the technology briefs might look like and in part because we thought it would be more difficult to involve suppliers in the assessment, due to the complexity of the systems. Although, we certainly hope that the next technology briefs can be shorter.

I would be happy to discuss this further with you. Let me know if you have questions.

John
734-355-155

To: Moran, Robin[moran.robin@epa.gov]
From: Carol Lee Rawn
Sent: Thur 7/2/2015 6:58:01 PM
Subject: Re: New EPA web page for the Midterm Evaluation

This is great Robin- thank you! Have a great break- look forward to talking to you in July!

On Jul 2, 2015, at 2:10 PM, Moran, Robin <moran.robin@epa.gov> wrote:

Hi Carol Lee,

I hope your summer is going well so far. I wanted to let you know about a new web page we've created for the light-duty midterm evaluation (MTE): http://www.epa.gov/otaq/climate/mte.htm

In the spirit of transparency throughout the MTE process, we wanted a place for the public to see the range of projects we have underway, and the products of our research (documents, publications, key presentations, etc.), as well as give more details on the timeline/process, and links to the work of our partners. As new MTE-related work is released, this is the place we'll post it.

Ex. 6 - Personal Privacy but maybe later in July we could catch up on how things are going with the auto profits study?

Take care,

Robin

Robin Moran

Senior Policy Advisor

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From: Jonna Hamilton
Sent: Wed 7/1/2015 6:00:55 PM
Subject: LDV technical meetings

Thanks for a good call today.

There will be no call next week, the 8th (it should already be canceled on your calendars).

On July 15th, the NGOs will share their current plans to provide data to weigh in for the TAR. If anyone has additional topics they want to cover on this call, please send me your ideas.

Thanks and Happy 4th,

Jonna

Jonna Hamilton

Senior Washington Representative

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